Review of 1916 Developments in Radio Engineering—*Fundamental Features of Present Day Transformer Design together with other technical and engineering articles and the regular departments*

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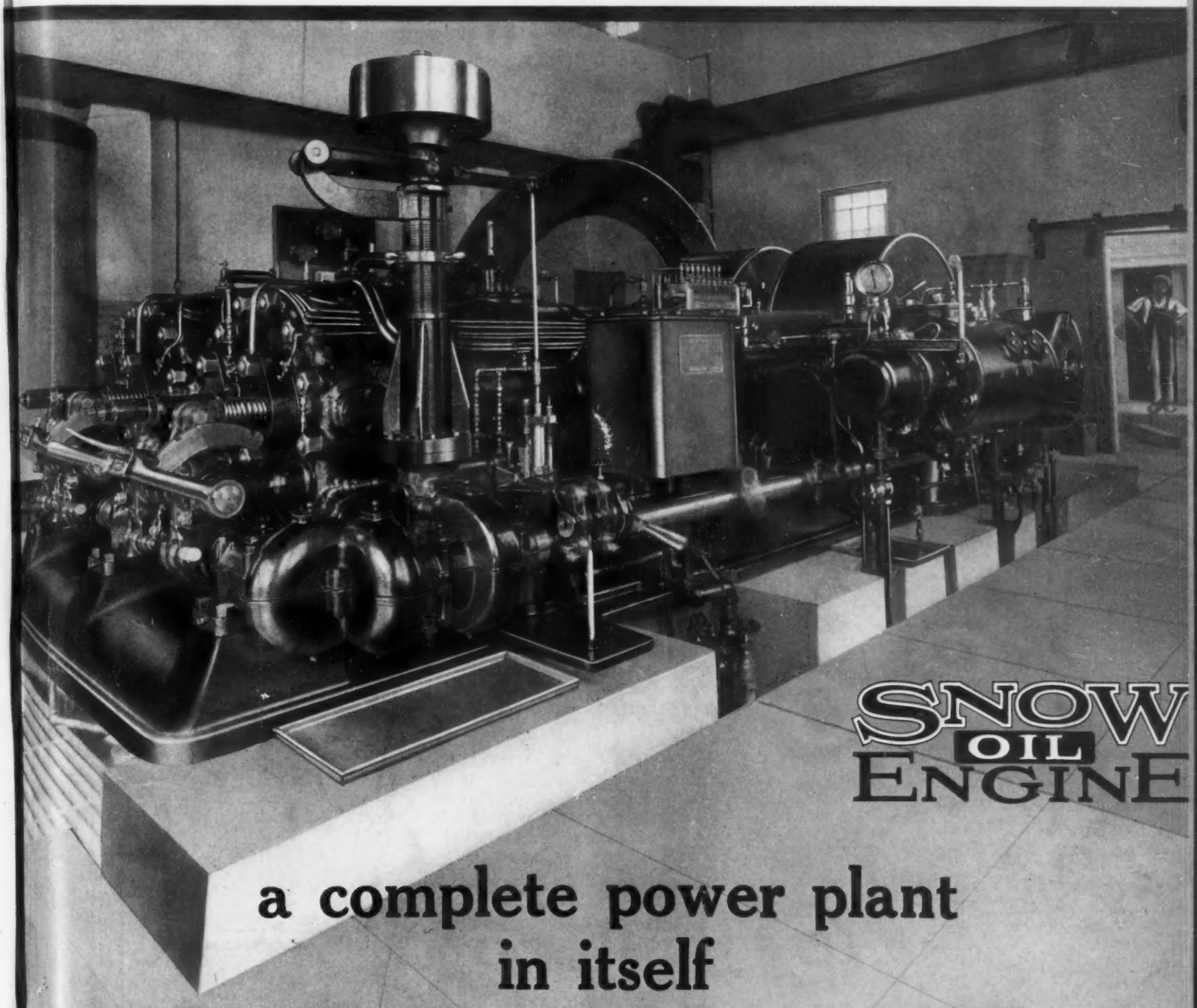

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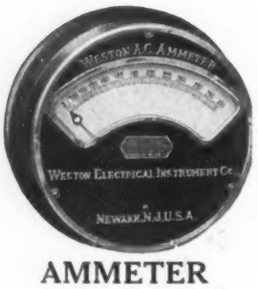

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Electrical World

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Henry G. Stott

AN excellent engineer and operator has passed away in Henry G. Stott. Always human, seldom complacent and never superficial, he won for himself a standing in the profession second to none; and engendered in the hearts of those privileged to know him a feeling akin to love. His administration of the affairs of the American Institute of Electrical Engineers was one of the best that body knew and his contributions, while perhaps not brilliant, were lasting in their effects and exceedingly helpful. Mr. Stott never spoke without saying something, and what he had to say was informative, constructive and satisfying. His knowledge of theory and of fundamentals was buttressed by a wide and intimate experience especially in underground construction and thermodynamics which caused him to be regarded as an authority in steam station practice and one of the most skillful and successful operators in the world. Original in all things, Mr. Stott was a leader and not a follower in his profession. Moreover he inspired confidence and his counsel was always sought on important engineering matters. Modest he was and sincere in all that he said and did. His home and professional life was one to pattern after, and his loss to the company he served and to the engineering fraternity in which he was wrapped up will be keenly felt.

The Central Station Load

CENTRAL STATIONS found that under the conditions prevailing last year they acquired large power loads formerly carried by isolated plants. A continuation of the same tendency of industrial power users to seek central station energy is generally anticipated this year. It is due partly to other considerations than those which are normally concerned in the question of the relative merit of the two classes of service for an individual installation. Scarcity and the largely increased costs of coal have emphasized to the isolated plant operator the advantage of a service involving little more than financial responsibility on his part. The extraordinary coal situation will enhance the business of the central station permanently if the problems which it causes can be solved without saddling additional excessive cost upon operating expense. Evidently central stations will have to figure rates on such business with eyes clearly open to the prospect that higher costs in some materials show no present sign of reaction. However, they have also to take into account the consideration that lessening demand in some industrial lines will mean smaller consumption of power in those directions, and will therefore leave a surplus for the better service of other customers whom they will try to hold fast.

Government Control of Radio Undesirable

THE article by J. L. Hogan, Jr., on page 120, draws attention to the rapid strides which radio signalling has already made in its brief history, as well as to the great need for inventive and engineering effort, in overcoming numerous existing difficulties in the way of further development. American progress in radio-communication has been particularly rapid; because the art has not been a government monopoly here, but has been open to free competition from all parts of the country. In Europe also, the progress has come from those individuals and organizations unhampered by governmental restrictions, and in those places where intellectual liberty and initiative have had sway.

The London International Radio Convention, having been subscribed to by the United States, has already hampered industrial radio-development here. It has laid severe and unnecessary restrictions on the use of a large range of wave-lengths. The air we breathe is no longer free, in the sense that all electric waves in it may be utilized for the transmission of intelligence by those who undertake to serve the public by sending their radio messages. Only a relatively small range is permitted to civilian use, the greater share being reserved to military service, where it is but little needed in time of peace. Moreover, the military authorities of the United States are given arbitrary powers in time of peace for the suppression of all use by civilian telegraphists of the pre-empted range.

As though this unnecessary invasion of the rights of public service radio-telegraphers in the use of the circumambient ether were not enough, a bill is now proposed for enaction by Congress, which will not only give to the military authorities of the United States a free entrance into commercial radio-communication but also increase their powers of regulation and restriction. In view of the freedom which governments affect toward patented inventions, and the length of an arm of interference which extends over the entire country, it is manifest that such legislation is likely to mean the speedy regulation of all commercial competitors out of existence, leaving the military in complete economic control.

Because all good citizens should loyally aid and support the military forces in time of war, is no reason for sacrificing the interests of radio-communication in times of peace. The military profession is so exacting

in its duties and requirements, that military men cannot properly attend to the invention and designing necessary for keeping American radio-communication in the front rank of preparedness. One might just as well hand over the control of radio-communication to the profession of law or the profession of medicine. It is no disparagement of either of these professions to say that they are necessarily unfitted to carry on and promote the development of radio-communication. If war does come, it is just as likely to come very suddenly, and much will then depend upon the state of development of the art of radio-communication in this country. The right way to be prepared is to leave the development of the art to radio engineers and inventors, and then to commandeer their services for military use. The wrong way and the one which legislation is designed to bring about is to leave it exclusively to the military departments of the government.

Designing a Station for the Future

IN this issue there appears a detailed description of the electrical design of the new Essex station of the Public Service Electric Company of New Jersey. Although only a quarter of its capacity has yet been installed the plant promises to be a large one, and when completed, with a probable rating of 200,000 kva., it will rank as one of the greatest generating systems in existence. Connected as it is to other plants operated by this company it has not been necessary to organize it as an independent unit, so that while it is designed ultimately for six large turbo-generators the two units now installed are rated at 25,000 kva. each. One of these is held in partial reserve. It is a plant of large generator units and large boiler units, a group of four boilers being allotted to each turbine. While the present generating sets are of 25,000 kva., subsequent ones will be of 35,000 kva. and possibly more.

If one were to pick out a single salient feature as characterizing the design of the equipment it would be an exceptionally high degree of automatism. Every effort has been made to depend as little as possible upon human attention, and the connections and apparatus are so arranged that whatever emergency may arise it will be cared for fully without waiting for the intervention of an operator. With the great service that the plant will have on hand it is imperative that continuity of supply be insured by every practicable means, and little has been left undone to this end. Not only the electrical equipment but the boiler plant is rich in special provisions for operating at high efficiency and with small opportunity for accident. Beginning even back of the boiler room at the coal tower, the fundamental idea of mechanical operation throughout appears. In the coal tower there is complete equipment for unloading the fuel from cars or barges, for crushing it to uniformity and conveying it to the coal bunkers, for unloading fuel, for storage in the coal-yard and for taking it thence for crushing prior to its transportation to the bunkers. From these it is mechanically transported to the conveying system that ends at the boilers. These are set high so that there is ample space in the basement for ash-handling devices, blowers, feed and other pumps and all the necessary accessories. The whole structure thus conveys the idea of being roomy and well arranged.

In the turbine room likewise extra space has been provided for the installation of larger units and for their assembly and repair by the aid of a 100-ton electrically driven crane. Directly under the turbine room is a high basement with condensers and other auxiliaries. A special feature of the layout is the switch house, six stories high and containing on one side the whole high-tension switch equipment, the other being devoted to the control room offices and miscellaneous operating requirements. One-half of the switchboard equipment has already been installed. The source of energy is found in the six turbo-generators which will make up the complete plant, and its distribution includes no less than sixty-six feeders, each of which requires full protection by switching devices, both to secure continuity of operation and to permit swift isolation at any point that fails. The penalty for thus concentrating generating devices must obviously be repaid by extraordinary care in the cable connections between the generator house and the main switch equipment.

The general arrangement of the switchboard is the grouping of one generator with its own bus and with a group bus for each generator providing the full interchangeability which would be found, for instance, on an arc switchboard. As the generators are designed for 13,200 volts, and the feeders of large capacity, oil switches have been installed throughout plus selector switches, so that each feeder may be connected with either of the two bus groups. In all there are twenty-five high-tension switches per generator, but this large number is chiefly due to the elaborate feeder requirements. Thus arranged, feeders can be quickly segregated and buses readily cleared for repairs. An important feature of the installation of generators of so large capacity is their protection from short-circuits in such manner that abnormally large capacity in switches will not be required. To this end reactors will be provided in the complete installation between each generator and its tie bus, and also in each high-tension feeder. By this means the maximum short-circuit current which can be thrown upon any switch will be kept below its full capacity for rupturing the circuit. The generator oil switches are protected by reverse power relays, and special relays also guard the tie-bus switches and feeders so as still further to lessen the danger from short-circuits. To the same end all the automatic oil switches are equipped with relays, which prevent their being held closed in case of closure on a short-circuit. Another group of safety precautions is that the control cable for each oil switch is carried in a separate conduit throughout. This and the other automatic devices similarly served implied a very large amount of conduit, nearly 50 miles being installed in the part of the system already completed. Most of the conduits to the switchboard system emerge in a con-

duit room, whence they are distributed to their destinations in the control room. Some particularly interesting devices are installed to protect the generators from difficulty with excitation. The regular exciters are direct connected, and at any signs of trouble the generator is thrown over upon an emergency storage battery until a motor-driven exciter can be started up from the control room and thrown upon the generator circuit, at which moment the battery automatically goes off. This abstract of the system can give hardly more than an idea of the extent to which human operators are dispensed with, but the engineer will find material for careful study in the investigation of the details outlined in the article.

Individual responsibility outside of the control further seems to have been eliminated as far as possible in the present state of the art. How far such automatic control can be carried to advantage has always been a mooted question among engineers. We certainly know of no instance which affords a more crucial test of the merits of the system or which shows greater ingenuity in providing for possible emergencies.

Electricity in the Automobile Show

ELECTRIC VEHICLES made a creditable and admired part of the display at the highly successful automobile show in New York last week. Electric vehicle makers had their exhibits attractively massed in one section of the Grand Central Palace and the distinctive beauty of their cars made them conspicuous features. Although the electric vehicle was the principal outward sign of electrical activity in an exhibit which was mostly of gasoline cars, electricity does not receive full credit for its incidental application in car operation. Certainly the automobile industry, although not commonly regarded as a part of the electrical industry, has points of intimate relation to it which suggest future possibilities of increasing importance. The electrical industry has many ramifications, and it is not dependent for its markets upon the development of automobiles. On the other hand, the automobile industry is dependent upon electricity, the incidental use of which has done much to foster the growth of pleasure riding. Electrical manufacturers will inevitably enlarge their activities in automobile parts and accessories. Rapid though the rise in the automobile industry has been, it still has ungaged opportunities for expansion. Sharp fluctuations in business will cause sharp fluctuations in the buying of pleasure cars, but expansion is bound to continue, and this will undoubtedly benefit the electrical industry in large degree.

Mechanical Principles of Transformer Design

THE ancient world boasted traditionally of seven wonders, which were all, save two, architectural. The modern world has many wonders, and one of them is the alternating-current transformer. In large sizes, it looks like a big black water tank, with conducting cables attached to it. Yet such a seemingly quiescent monster may be receiving, transforming and delivering many megawatts of electric power. If the same power existed in mechanical form, we should witness large stresses moving with high speeds; but in the electric form all is invisible. In the article by Messrs. McConahey and Peters elsewhere in this issue, some of the history of this wonderful development of the transformer is briefly reviewed. The development has been nearly all in America, and the world owes to American engineers the greatest share of the initiative, courage and skill in design which have made the modern transformer the wonder that it is to-day.

In the early days of transformer design, the electric properties of the apparatus occupied almost exclusive attention. It was required to give a certain rated output with satisfactory pressure regulation, adequate insulation, and low internal heating. As the size and power of the apparatus increased, however, mechanical deformations presented themselves after accidental overloads or short-circuits. The designers were brought by experience to realize that a transformer, being an electromagnetic device, developed electromagnetic forces in its windings that might become very large under occasional conditions of accidental excessive load. This necessitated the introduction of ample mechanical support along with the ordinary electrical requirements, and the elimination of certain types of structure in which the electromechanical stresses became difficult to resist. The nature and directions of these stresses are presented clearly in the article. The subject is of importance to operating men, as well as to designers; so that it should be studied by all who come into industrial touch with transformers.

The Coming Issues

NEXT week's ELECTRICAL WORLD will be the fourth or commercial number for January, and a feature of that number will be an article on customer growth and rate reductions, recounting the experience of two Middle West central station companies in revising downward their rates for electric service, in conformance with a pre-announced schedule, as the number of their customers increases from time to time. The account of the electrical features of the new Essex plant of the Public Service Electric Company of New Jersey, begun in the issue now before the reader, will be completed in the Jan. 27 number. Other broad commercial topics of interest to the lighting company executive and manager will be treated in the commercial issue, which will also contain the regular departments for the engineer and operating man. The first issue of February will deal largely with matters of public policy in the management of central station properties, and the second number of that month will contain engineering articles of particular interest to the station and operating man. The January number of ELECTRICAL MERCHANDISING, the new monthly magazine of the electrical trade, appeared on the fifteenth of the month, and to it are referred readers who are interested in detail merchandising and business methods.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

OHIO NEW BUSINESS MEN PLAN MONTHLY CAMPAIGNS

Methods of Handling Customer Complaints and Considerations Necessary in Campaigning for Industrial Heating Business Discussed at Toledo Meeting

Plans for handling 1917 campaigns dealing with customers' complaints and getting industrial heating business were the outstanding features of the Ohio new-business men's meeting at Toledo on Jan. 18. Favorable opinion was expressed on the idea of having a special drive on some appliance each month, all fitting into a general plan for the year. The arrangement of the Toledo plan which seemed to be acceptable to all is as follows: Washing machines in February and June, cleaners in March, house wiring in April, and irons in May. These appliances are to be rotated for the summer, fall and winter months except December and January. The thought that each campaign should be planned at least thirty days in advance was emphasized.

A paper by Frank Wert of Youngstown, entitled "Is the Customer Always Right?" opened an enthusiastic discussion of methods for handling customers' complaints and brought out the fact that all companies should assume the customer right unless he is proved to be in error. The keynote of the talk on "Industrial Heating," by H. J. Kuntz of Toledo, was that the installation of each prospective customer should be analyzed on the basis of the reduction in over-all production cost possible through the application of electric heating processes. On some jobs, said he, the actual fuel cost for electricity may be eleven times what it would be with oil or gas, yet the over-all saving with electricity may decide the case in its favor.

PHILADELPHIA ELECTRIC MAY NOW MERGE SUBSIDIARIES

Pennsylvania Commission Approves the Application Upon an Agreement That the Cost Be Borne by the Stockholders and Not by the Consumers

Upon agreement by the Philadelphia Electric Company that the cost attending the merger of the fourteen subsidiary companies located in Philadelphia should be borne entirely by the stockholders and in no way affect the customers of the company, the Pennsylvania Public Service Commission on Monday last approved the merger of all of the underlying companies under the corporate title of the parent company.

The company's refinancing plans, announced last summer and reported in the ELECTRICAL WORLD for July 29, 1916, will undoubtedly have by this move a clear road. The plans as thus announced provided for increasing the authorized capital stock to $50,000,000 and an authorized bonded indebtedness of $60,000,000, to be secured by a first mortgage maturing in fifty years and bearing interest at the rate of 5 per cent.

In announcing the plan, President McCall said:

"To provide the necessary capital in order to meet the increasing requirements of the public and to continue that high character of service which we feel it our duty as a public service company to furnish the community, it is necessary to refinance the property on a broad, substantial basis which will provide for the demands of the consumers."

The commission has had the matter of permitting the merger under consideration for months. It refused to act last week on the ground that it desired more information regarding the terms of the transaction.

The point at issue involved the premiums at which the underlying bonds were to be taken in. Commissioner Michael J. Ryan is said to have opposed the company's suggestion to take this sum out of gross earnings on the basis that it might open a way to saddle the cost on the consumer by offering an opportunity to increase rates. Mr. Ryan's contention, it is understood, was to deduct this cost from net earnings. In that way, whatever expenses were attendant would fall on the stockholders entirely. This method was adopted by agreement.

CONTRACTORS CONSIDER WAYS TO REDUCE COSTS

Wisconsin Association at Annual Meeting Discusses Plans for Co-operative Buying and Estimating Now Being Used Successfully in Milwaukee

At the fourteenth annual meeting of the Electrical Contractors' Association of Wisconsin, held during the first three days of the week at Milwaukee, co-operative buying and quantity estimating were the subjects which claimed closest attention. A. M. Kailing of the A. M. Kailing Company, Milwaukee, outlined a co-operative buying scheme which six Milwaukee electrical contractors have been using successfully. C. E. Flamboe, manager of the estimating on jobs in Milwaukee County for twelve building concerns, told how this bureau was operated and what were its advantages. It is the duty of this bureau to work out from plans and specifications a detailed list of all material needed for any job on which the twelve member concerns wish to bid. This data is then handed to all members and they themselves put their own prices on the job.

In this way the bidding is done on a competitive basis but the actual labor of estimating is performed in one operation for all twelve companies. The plan eliminates the trouble which arose with architects who were unwilling to provide twelve separate plans and specifications in order to give all of the bureau men a chance to bid. It also substitutes the work of one estimator for the work of twelve separate estimators and it provides each bidder with a more accurate set of figures upon which to base his bid than he could himself work out in the limited time he usually has for such jobs.

In discussing the advantage of this plan William H. Schmidt, Jr., one of the members of the bureau, said it now costs him $40 a month on the average for the estimating which is done for him by the bureau. The saving which has been effected through this plan in his particular instance may be appreciated from the fact that it formerly cost him from $125 to $150 per month for estimating. The cost of the bureau to its other

members ranges between $25 and $90 per month, depending upon the gross amount of business they handle.

Following this presentation of their plan by the Milwaukee mill men, the contractors discussed it with relation to their business, and while no definite decision was taken before the final closed session it was understood that the contractors were considering a trial of the plan in Milwaukee County. Beside the three closed sessions at this meeting one session was open to other than member contractors. At this meeting the speakers were P. T. Bowler on "Selling Electrical Applications;" J. R. Morrisey on "Enforcing the Underwriters' Rules;" W. D. Kellogg on "Farm Lighting Plants," and S. A. Hobson on "Jovianism." In the future it will be the plan of the Wisconsin contractors to hold four meetings annually in order better to foster the spirit of co-operation.

DEATH OF HENRY G. STOTT

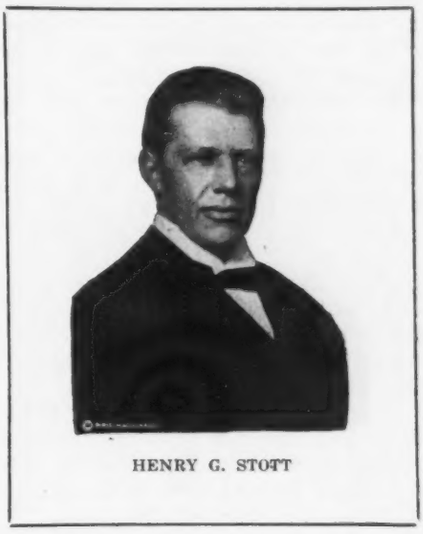
Noted Engineer and Operator Passes Away After Lingering Illness—Synopsis of His Career

Henry Gordon Stott, past-president of the American Institute of Electrical Engineers and superintendent of motive power of the Interborough Rapid Transit Company and New York Railways Company, died at his home in New Rochelle on Jan. 15, after an illness of many months.

He was a native of the Orkney Islands, Scotland, where he was born in 1866, the son of the Rev. David and Elizabeth Jane (Dibblee) Stott. After a thorough grounding in the fundamentals at the hands of his father and elementary school instructors he was enrolled as a student at the Watson Collegiate School, Edinburgh. On leaving this institution he entered the College of Arts and Sciences at Glasgow, and began a course in mechanical engineering and electricity, graduating in 1885. In the year previous he had entered the employ of the electric illuminating company of Glasgow. Shortly after graduating he was made assistant electrician on board the steamship Minia, belonging to the Anglo-American Telegraph Company. The next four and one-half years saw him engaged with those duties, during the course of which he saw much service in connection with repairs to the cable lines of that company. In this period he undertook a number of experiments that resulted in the introduction of improved methods of handling cable repairs. He was also identified with the "duplexing" of the United States Cable Company's main cable (2750 knots), the longest duplex cable in the world.

In 1889 Mr. Stott was made assistant engineer of the Brush Electric Engineering Company's plant at Bournemouth, England. The following year he was offered a post by Hammond & Company as assistant engineer in the construction of an underground cable and power plant at Madrid, Spain. He remained there until 1891, coming to the United States in that year to install an underground cable and conduit system for the Buffalo Light & Power Company (now the Buffalo General Electric Company). This work was completed with a degree of success that reflected very greatly to the credit of Mr. Stott. As a result he was named engineer of the company, and during the next ten years was one of the most active figures in the industrial progress of Buffalo. During this period he designed and executed some notable construction work, including a power plant on Wilkeson Street, Buffalo.

His efforts attracted wide attention, and in 1901 he was appointed superintendent of motive power of the Interborough Rapid Transit Company, New York City, a position which he has filled with signal success. At the time he took up these duties the Interborough had not yet been organized, the company having the title of the Manhattan Railway Company. The post which Mr. Stott was called to had just been created, and it devolved upon him to organize the operating force, in connection with which he completed the Seventy-fourth



HENRY G. STOTT

Street power plant of the company, various substations and transmission lines.

When the Manhattan system was amalgamated with the Interborough in 1904 Mr. Stott was invited to retain his office with the new corporation. He accepted and immediately took over supervision of the construction of the power plant on Fifty-ninth Street. Since that time he has been constantly in charge of design, construction and operation of the power generating stations and the distributing system of the Interborough, which comprehends both the subway, elevated and surface lines of New York City.

The plans for the electric power system of the new subway lines have been developed under his supervision, and the work has progressed so far and bears so strongly the stamp of his work that, when completed, it will be a monument to him.

Mr. Stott was a firm believer in co-operation among engineers, through the agency of engineering societies. He was president of the American Institute of Electrical Engineers for the term 1907-1908, vice-president of the American Society of Mechanical Engineers for the term 1912-1914, director of the American Society of Civil Engineers in 1911, and was vice-president and trustee of the United Engineering Society at the time of his death. Up to the last Mr. Stott was a recognized power in the American Institute of Electrical Engineers, and was a member of the standards committee, public policy committee, the committee on development of water power, the United States national committee of the International Electrotechnical Commission, the power stations committee, the committee on economics of electric service, Edison medal committee, and was one of the institute's representatives on the joint committee on the metric system, of which he was an ardent advocate.

As a result of his unusually wide experience and extended research, Mr. Stott has been called upon often to contribute papers to the various engineering societies. He was especially well known for his minute analysis of engineering problems. Among the large number of papers which he has written on this subject are: "The Conversion and Distribution of Received Currents," "Power Plant Economics," "Notes on the Cost of Power," "Steam Pipe Covering and Its Relation to

Station Economy," "Tests of a 15,000-kw. Steam Engine Turbine Unit," "Power Plant Design and Operation" (a series), etc. He acted as consulting engineer for the Buffalo General Electric Company and had much to do with the design and equipment of that company's new steam station now building near Tonawanda, N. Y., the completion of which he looked forward to with much pleasure and satisfaction. He confidently expected that it would be the most efficient steam-generating station so far built, and that it would easily compete with Niagara Falls water power in cheapness of energy production.

Mr. Stott was a remarkable figure in the engineering world, because he was in the front rank of both electrical and mechanical engineers, because in both branches of the art he was a master of theory and practice, and because with these technical qualifications he combined a rare executive ability, power of inspiring the confidence of his employees and of bringing out the best that was in the men who worked for him.

Mr. Stott's activities were not confined to engineering matters. He early became a citizen of the United States, and served for five years in the Seventy-fourth Regiment of the National Guard of New York State.

He was married on July 22, 1894, to Miss Anna Mitchell of Belfast, Ireland, who with their two children, a son and a daughter, survive him.

WATER-POWER BILL UP FOR DISCUSSION IN SENATE

A Number of Senators Make Efforts During the Debate to Amend the Bill—Doubtful if Bill Will Receive President's Signature During This Session

The Senate has voted to make the water-power bill, to provide for the development of water power and the use of public lands in relation thereto, as the unfinished business of the Senate, and it is now before that body and will be so until voted upon. This is House Bill No. 408, which has passed the House. The bill is now being debated, and comes up automatically every afternoon, under the unfinished-business rule.

This action was taken by the Senate on Dec. 9, as the result of a Democratic caucus the previous night. The bill is in charge of Senator Walsh, and favorable action on it was obtained only after a filibuster against it by Senator Townsend, who desired to press an army bill he has been supporting for six years. Senator Townsend, Senator Jones and others will amend the water-power bill or attempt to do so during the debate. Senator Jones declared that the caucus has coerced "those who are in favor of this measure, and will compel them to vote against their sentiments with reference to it."

The Senate has continued during the past week the consideration of and debate on the bill, and the week in Washington has also been marked, as to water-power matters, by a conference at the White House between President Wilson and Representative Adamson, chairman of the House committee on interstate commerce, concerning the general dam bill. Mr. Adamson is endeavoring to obtain from President Wilson support as to the passage of the dam bill, which is in conference between the two houses of Congress, the conferees being unable to agree on items in the bill providing for charges for dam rights.

Most of the argument in the Senate on House Bill No. 408 has been of a legal character. Questions of leasehold values, taxation, etc., were gone into. Concerning the value of a leasehold, for taxation purposes, Senator Shafroth of Colorado, said:

"When you consider that all this is hedged about by the fact that there shall be a utility commission that will not permit a company to earn more than a reasonable rate, the leasehold would be of absolutely no value. Consequently, even if there was a liability there would not be a liability for the payment of taxes, because the leasehold is made by the very act itself, so that it cannot become valuable. If you limit the amount of money that can be charged by these companies, so that they cannot for instance make more than 6 per cent per annum, what value is there in a leasehold estate?"

Senator Walsh, who is in charge of the bill, said in support of it that "when the proposed commission comes to fix a rate, it must first allow all expenses, taxes and everything else, and then it must allow a fair return on the money invested besides."

Senator Shafroth replied: "That may be, but the difficulty about that is that what they have got as an initial investment, being curbed and limited by the proposed utilities commission itself, would make it impossible for the investment ever to be worth anything over and above the cost of the enterprise in the first instance."

One of the most important statements made so far during the debate was that if the bill becomes a law $300,000,000 would be invested in water powers.

A number of amendments have been tacked on to the bill or offered for possible consideration. Senator Norris desires to amend the bill by providing that in granting leases under the act the Secretary of the Interior shall give preference to applications for leases for development of electrical power by states, counties, municipalities and government irrigation districts. In all such leases no rent or fee of any kind would be charged. In lieu of such leases to any state, county or municipality, or at any time after the making of the same, Senator Norris, in his proposed amendment, would provide that the Secretary of the Interior on demand from the proper authority shall execute to any state, county or municipality a patent for the property so leased or authorized to be leased by the provisions of the act. Penalties of reversion of rights to the United States are provided in case rights granted are not taken advantage of. Senator Works has offered an important amendment to the bill which is in effect the substitution of another bill for the one under consideration. The pending bill provides principally for the leasing of water-power sites on public lands. Senator Works' proposed amendment provides for the sale and granting of those rights for a price either to be determined upon between the Secretary of the Interior and the purchaser, or, if they are unable to agree, then by procedings in court. Senator Works would provide that the sale may be made to any person who has acquired the right to divert and distribute and use the waters under the laws of the state in which the water power is situated. His proposal distinguishes from the pending measure particularly because it provides for the sale rather than for the leasing of water-power rights.

The bill continues to be the unfinished business of the Senate, a tactical position which might seem to give it some assurance of being voted upon soon, but there are many bills on the calendar of the Senate in which Senators of all political parties have special, private interests, and the water-power bill will be displaced by common consent from time to time for the passage of those bills, making for a delay in the final action upon it. The bill will certainly be so amended when it leaves the Senate that it is doubtful if the House will pass it, and there is even doubt as to whether conferees could agree upon it in the few days remaining of the present session of Congress.

CONGRESS PROPOSES TO TAX BUSINESS $214,000,000

Part of Sum Needed to Wipe Off Portion of National Deficit and to Provide Money for Next Year—Proposed Tax on Raw Materials Abandoned

The ways and means committee of the House of Representatives—the revenue-producing body of the House—with, it is formally announced, the approval of President Wilson and Secretary of the Treasury McAdoo, has decided to wipe off some of the enormous deficit in the Treasury and to provide the money needs of the country for next year by imposing a tax of 8 per cent on corporations and co-partnerships on net incomes over $5,000 after 8 per cent normal profits (dividends) has been deducted. Other revenues will be produced by an additional inheritance tax. Other requirements will be met by bond issues, some of which have already been authorized in special laws.

The sum of $525,000,000 is needed for the government. Of this, the proposed tax on business, from corporations, is expected to furnish $175,000,000. The proposed tax on business co-partnerships is expected to furnish $39,000,000. The inheritance tax (additional) is expected to yield about $22,000,000.

For the present, the ways and means committee has abandoned the proposal considered last week to tax automobile engines, and output taxes on petroleum, copper, aluminum, pig iron and rubber. Chairman Kitchin of the committee has been authorized to draft a bill along the lines outlined above. The 8 per cent tax on business now proposed is 3 per cent more than was proposed last week.

The proposed taxes of $236,000,000 on business and inheritances outlined above are in addition to the bond issues which will be necessary to finance the government.

TARIFF AND FEDERAL TRADE COMMISSION VACANCIES

Speculation Continues Keen in Washington Concerning the Personnel of These Commissions, Especially the Tariff Commission

Edward N. Hurley, chairman of the Federal Trade Commission, having resigned from that body, to take effect Feb. 1, there are now practically two vacancies on the commission which the President must soon fill. Commissioner Rublee has never been confirmed by the Senate because Senator Gallinger has said Mr. Rublee is "personally obnoxious" to him, Senatorial courtesy allowing the Senator from New Hampshire to prevent the confirmation.

In this connection it is reported in Washington that President Wilson is considering the names of a number of men who would make suitable appointees on both the Federal Trade Commission and the new Tariff Commission, and that he may be expected to announce the names of the latter commissioners shortly. Almost the same type of man is wanted for both commissions. It is believed extremely unlikely that President Wilson will again send the name of Mr. Rublee to the Senate, especially as Mr. Rublee has been named as a member of the board headed by General Goethals, to observe the working of the so-called Adamson "eight-hour" railroad act.

There is much speculation in Washington concerning the prospective commissioners on these two bodies, and in regard to tariff matters. Secretary McAdoo and the ways and means committee of the House are searching for many additional articles to tax, in the form of tariffs or otherwise, owing to the big deficit in the public funds. The tariff commission when appointed will have much to say on these matters before any definite decision is made.

REGENERATIVE BRAKING DISCUSSED BY A. I. E. E.

Entire Technical Session Held in Connection with the Pittsburgh Meeting Devoted to Consideration of the Subject

The 328th meeting of the American Institute of Electrical Engineers was held at Pittsburgh, Pa., on Jan. 12, under the auspices of the Pittsburgh section of the traction and transportation committee. The session was called to order by President H. W. Buck who introduced R. E. Hellmund of the Westinghouse Electric & Manufacturing Company who spoke on the subject of regenerative braking.

Mr. Hellmund described twenty-one different possible systems for regeneration, explaining in detail the advantageous features and limitations of many possible methods of obtaining regeneration with different types of motor. He attributed the meager use made of regenerative control to the hitherto increased complication and decreased reliability, but said that this condition has changed and that ordinary requirements for reliability and safety can now be met with a high degree of success.

Regeneration with three-phase motors does not introduce any complication, and to obtain satisfactory results it is only necessary to provide electrical equipment of sufficient capacity to take care of the regenerative current. With the three-phase system, however, the possibilities for reducing the speed below the synchronous speed of the motors are either very limited in scope or necessitate the installation of cumbersome equipment and their application in practice does not seem to be very likely in the near future. The difficulties prevailing with a phase-converter system employing a single-phase line and a phase-converter locomotive are practically the same with regard to regenerative braking as with the three-phase system.

The present-day direct-current railway motor lends itself less readily to regeneration than the polyphase induction motor. Separate excitation offers the most promising possibility for successful regeneration and the author described six of the more important requisites that have to be considered in all cases. He then discussed the principal characteristics of the source used for separate excitation and the consequent characteristics of the main generator.

The result of regeneration upon direct-current lines may at times be rather disadvantageous with regard to fluctuations in line voltage. The difficulty of connecting alternating-current generators to the line, however, is materially reduced as compared with direct-current motors because the inductive effect of an alternating-current system materially reduces the tendency toward current peaks.

The paper was discussed by Robert Lundell of New York City; E. W. Alexanderson, of the General Electric Company, Schenectady, N. Y.; Mr. Hall of the Westinghouse Electric & Manufacturing Company; R. E. Ferris and W. V. Turner, chief engineer of the Westinghouse Air Brake Company; H. M. Hobart of the General Electric Company; F. R. Phillips of the Pittsburgh Railways; Prof. C. A. Adams of Harvard University, C. L. Fortescue, of the Electric & Westinghouse Manufacturing Company and W. B. Potter of the General Electric Company.

Electric Transmission of Intelligence in 1916-1917

Developments in Telegraphy, Telephony and Radio Engineering, Including Progress in Transoceanic Communication and Control of Radio Stations

By John L. Hogan, Jr.
Chief Research Engineer, National Electric Signaling Company

JOHN L. HOGAN, JR.

LINE wire telegraphy and telephony in the United States have been so completely standardized and give such excellent service under normal conditions that there is little indication of any radical change to be expected to the practice of either. Vacuum tube amplifiers of the "audion" type are finding greater and greater use in the electrical transmission of speech, and it is presumed that they will be further extended. Minor improvements which increase service effectiveness are of course made almost daily, and will doubtless continue to appear. In wire telegraphy, the extension of printing systems is to be noted. Keyboard transmitters (operated by girls having no knowledge of Morse), connected in synchronous quadruplex relation to page-printing receivers, obviously increase line capacity and decrease message transmission costs where the volume of traffic is large. In addition to the synchronous multiplex printers, one or two forms of non-synchronized printing telegraphs have demonstrated their practicability and will in all probability find further commercial applications during the coming year.

Submarine cable telegraphy is also an art in which basic changes must come slowly. Like the wire line systems, the existing plant meets all normal needs. Alterations which, because of their radical nature, involve the necessity of abandoning reasonably satisfactory apparatus and which consequently are extremely expensive, can only be made after experience has shown them actually to be essential. Various proposals of interlinking wire telegraph and cable systems by direct relays, to avoid manual repetition of messages, as well as plans for distortionless alternating-current working, were brought out during the year just closed. Which schemes possess genuine practical merit can scarcely be determined without extended tests on a commercial scale; it seems unlikely that any large application of either of these general plans will be made in 1917. The use of magnifiers, usually of the galvanometer-controlled heated-wire type, is said to be proving important in increasing cable speed and signalling reliability. In all probability, therefore, installation of these instruments will be continued.

New Devices and Methods Appearing

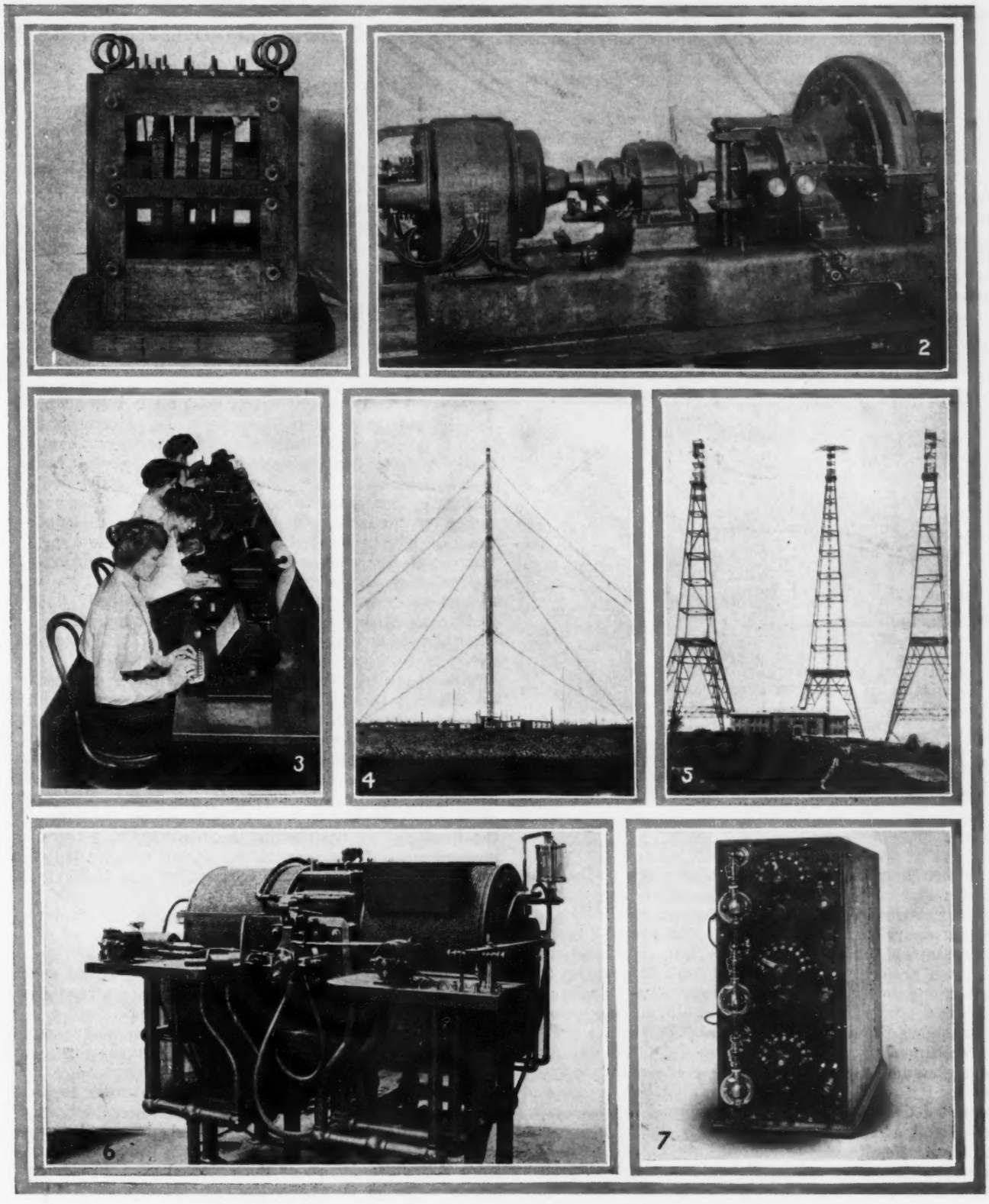
When the young arts of radio signaling are considered, however, very different conditions are found. Both in radio telephony and radio telegraphy new devices and modes of operation are constantly appearing. The commercial practice is fairly well defined, and entirely satisfactory within proper limits, but new inventions (or new applications of old ideas) continually tend to extend the limits and to make radio available for new uses. It is true that the presentation of novel schemes in general merely changes the relative emphasis placed upon various elements of the radio systems as a whole, and ordinarily does not enforce any basic readjustments; nevertheless, the presence of inventive effort keeps the arts in a state of flux and results in an almost phenomenal growth toward the highest points of commercial utility.

In radio telephony, for example, nothing fundamentally new has appeared since the earliest work involving vocal modulation of a continuously radiated stream of sustained electromagnetic waves. Yet the practical work of the first experimenters has been completely eclipsed, in so far as magnitude is concerned, within the past year or so. The transmission of speech across the Atlantic to Paris, and over the continent and the Pacific to Honolulu was accomplished in 1915 by the effective modulation of some 10 or 15 kw. of radio frequency power. During 1916 has come the announcement that speech vibrations have been used for the vocal control of powers some five times as great. Though the distance effect of such a powerful radio telephone transmitter has not been demonstrated, it is obvious that transoceanic distances should be covered with much greater ease and uniformity than in the 1915 tests. Sound-wave control of still higher powers seems just within view, and it has been stated in an entirely confident manner that the coming year would see speech transmitted by radio over the 4000 miles which separate the United States from Germany.

It is particularly interesting to compare these great distances covered by radio telephony with the limits of length of telephone cable over which speech is effective. Now that wireless telephonic accomplishments are rivaling those of the line telephone in the matter of distance, the possible technical and economic advantages inherent to the radio method are becoming more widely appreciated. Concentrated plant maintenance, distortionless transmission, and depreciation-free trunk "lines" are points of superiority which will be given further consideration.

Atmospheric Interference

An important difficulty which confined radio telephony to short-distance working was that of modulating the high frequency power in accordance with voice waves. This problem seems to have been solved in a large measure by the development of magnetic and vacuum amplifiers. The generation of powerful streams of sustained waves, for either telegraphy or telephony by radio, has been practicable for many years. There remains in both branches of the wireless art, however, what is perhaps the most difficult problem of all. This is the elimination, or reduction, of the harmful effects of atmospheric interference. Until the "stray" or atmospheric problem is solved, wastefully large power is essential at the transmitting station, for the signal at the receiver must be so strong as to dominate the sounds of "static." Long distance signaling dependent upon the use of delicate amplifiers at the receiving station, as in the 1915 radio telephonic tests across the oceans, can be practiced only when atmospheric interference is substantially absent. The reason for this condition is, of course, that the receiving amplifiers commonly magnify the interfering effect of "strays" as much or more than the desired signals. Once the atmospherics are eliminated or re-



1—Magnetic amplifier used for controlling powerful radio-frequency currents. The output of a microphonic transmitter, once amplified through a vacuum tube, has modulated telephonically some 75-kw. of radio-frequency power.

2—75-kw., 50,000-cycle, high-frequency alternator for radio telegraphy and telephony. When connected directly to a tuned aerial wire system, this machine generates a continuous stream of 6000-meter ether waves.

3—Page printing telegraph with girl operators sending from one end of a quadruple duplex installation. A single wire with ground return is thus used, on the synchronous distribution plan, to transmit simultaneously eight messages. Each is automatically typewritten by the receiving machine at from forty to sixty words per minute.

4—The main tower of the new Sayville, Long Island, wireless station, which is in daily communication with Nauen, Germany. Two other 500-ft. towers have been erected, and, together with the central tower shown, support a "roof" antenna having a ridge length of about 2000 ft. 200-kw. is used in signaling across the 4000 miles to the station near Berlin.

5—The United States government station at Arlington near Washington. The central tower is 600 ft. high, and the others 450 ft. Trans-Atlantic telephony was first accomplished from this plant.

6—Poulsen 100-kw. arc transmitter used during San Francisco-Honolulu tests. A typical form of this type of undamped wave generator. The arc discharge in a strong magnetic field is such that it produces sustained electrical oscillations of radio frequency.

7—DeForest audion amplifier. The characteristic structure of hot filament, cold plate and intermediate grid electrode is embodied in each of the three evacuated tubes shown. Such devices are capable of magnifying telephonic currents without introducing great distortion.

duced before the amplifier is reached, however, feeble incoming or received power may be built up materially by local telephone relay action, and a corresponding saving in transmitter power will result.

During 1916 a number of new proposals for stray reduction have been brought forward. It seems likely that during the coming year at least two of these methods will have sufficiently extended practical trials to determine their true commercial value. In the past fifteen years or so a vast group of static-preventing schemes have been tried and found worthless for their intended purpose. Nevertheless, by the elimination of many false ideas on atmospherics (rather than by the elimination of the interference itself) these early plans have been of material assistance in the growth of the art. When a well-informed radio engineer of to-day brings forward a stray reducing invention, the probability that it will prove useful is far greater than was the case under equivalent circumstances some five years ago.

The "static" problem is not the only one engaging the attention of workers in the art, though it is probably of the greatest basic importance. The combination of sustained wave generation by arc or machine having radio frequency output, with "heterodyne" or electrical beat receivers, has already provided a practical freedom from atmospheric disturbance which makes long distance radio telegraphy entirely practical. The main advantage to be secured from further stray reduction is the great economy of sending power (and the consequent simplification of transmitter design and construction) which will result. Since this is a matter controlling the size of profits to be gained, rather than determining commercial operability, many engineers have directed their energies along other lines. The transmission of messages over great distances at high Morse speeds in the neighborhood of 100 words per minute, and the automatic recording of received signals in such systems, are approaching conditions of practical performance. In fact, such "rapid" systems are already in use at some of the most important trans-oceanic stations.

COMMERCIAL OR GOVERNMENTAL OWNERSHIP

Although much attention is being given to the difficulties emphasized by the conditions of long distance radio signaling, steady improvement in local and ship-to-shore service is to be noted. The probability that generators of undamped waves suitable for ship working, and producing the extremely high frequencies corresponding to the 300 and 600 meter wave lengths specified by law, will be brought out during the coming year, shows the drift of all branches of the art toward the continuous-wave method. Ship-and-shore communication has had a hard struggle against restrictive legislation of a most unintelligent sort, but has grown and improved despite the handicaps imposed by the Berlin and London International Radio Conventions. The military interests of the federal government, acting in the name of "preparedness," are now urging further and stricter laws to govern the commercial operation of radio telegraphy. It is admitted that the proposed legislation is intended to make possible, if not inevitable, the naval ownership of coast radio stations involved in ship-to-shore signaling. Commercial, scientific and non-military interests are opposing the Navy Department's campaign. The outcome is not yet in sight, but the conflict promises to be memorable. Its result will determine whether radio signaling in the United States will continue to hold its present position of pre-eminence, or whether the art will be subject to the initiative-killing suppressive policies of military ownership and domination.

SOME NEEDS OF THE ILLUMINATING ENGINEER

Illumination Considerations That Involve Design, Selection and Installation of Fixtures for Gas-Filled Tungsten Lamps

BY DR. LOUIS BELL

This brief article is written in the hope that it may stir to activity the designer of illuminating accessories, bring the maker to an appreciation of some missed opportunities, and perhaps bring into the spotlight some excellent devices already at hand but not yet as widely known as they deserve. The coming of the Mazda C lamp into wide use has materially changed the requirements for lighting accessories like shades, globes and reflectors. The Mazda C lamp does not interchange readily in the devices convenient for the older type. This difficulty was appreciated from the very first and has been in part remedied, so that special lines of fixtures have been brought out at least fairly well adapted for the new illuminant. Yet the range of fixtures for type C lamps is still limited, and in particular there is need for socket and shade holding adapters so that many excellent installations of glass ware can be conveniently utilized. This work is under way, but it is far from complete. Somewhat more serious are the difficulties brought by the concentrated filament of the type C lamp, valuable for some purposes yet presenting a source of such enormous brilliancy that it requires special treatment. Globes which were entirely unobjectionable with the type B lamps glare very seriously when equipped with type C and in many instances the new filament shows a conspicuously bright spot.

The concentrated source of light, too, complicates considerably the design of many excellent types of semi-indirect fixtures; the shadows at the edge of the bowl become hard and unpleasant, and the chain shadows, too, form black markings on the ceiling much more obtrusive than those due to the more extended filament of the earlier lamps. To overcome the former difficulty particular care has to be used in planning the edge of the bowl and in positioning the filament with the utmost accuracy. Here again a suitable set of adapters would be a great convenience in getting the filament at exactly the right point. Likewise the chains should be lightened and so positioned as to diminish the shadows as far as feasible. As regards the material of the bowls the filament does not as a rule show through conspicuously, but often produces a bright diffused spot which greatly detracts from the appearance of the fixture when lighted. Here again careful positioning of the lamp is necessary, and as the type C lamps are now fitted for horizontal burning multiple fixtures can and should be used very much more than they were at first. Extra care has to be exercised in order to obtain a suitable diffusion of the light between the transmitted light and the reflected rays, and in general terms the bowl design can well be modified in the direction of more oblique incidence of the reflected rays, producing better diffusion on the ceiling and at the same time lessening the effective transmission.

In general, too, the size of bowls, and for that matter globes, or other inclosing shades, must be somewhat larger than with the earlier lamps to avoid too great intrinsic brilliancy. If one stops to consider the apparent area of the diffusing screen used, for instance, to house a 500-watt lamp and measures the light transmitted, it will often be found that the intrinsic brilliancy of the fixture runs very much higher than is desirable for good illuminating practice. This difficulty is in part due to lack of thought in changing illuminants, and in part to the constant and very natural

tendency of manufacturers to keep down cost of fixtures by diminishing their size. There are a good many fixtures adapted for type C lamps on the market, which, from the standpoint of intrinsic brilliancy, are absolutely intolerable with the size of lamp for which they are listed. This same difficulty was conspicuous in the days when open shades were the general rule. There was a constant tendency to make them just a little too small, and the writer for some years habitually used with a given lamp the next larger size of shade to get the skirt deep enough to protect the eye. This difficulty, both with open shades and with inclosed ones, is greatly aggravated by the type C lamp and a little more liberality in the matter of sizes would improve the situation very much. It is true that the commercial pressure of costs is against this change, but on the other hand good engineering demands it. It is one of the inevitable penalties paid for having available an illuminant of peculiarly high efficiency. Part of the advantage gained in watt consumption has to be sacrificed in many cases to requirements of proper installation.

Finally, there is an increasing call for shades of color somewhat toned in order to avoid the extreme whiteness of the type C lamps. This is extremely useful for some purposes as witnessed by the rapidly increasing use of these units, and even those in which still higher efficiency and a blue bulb gives the daylight effects sometimes greatly desired; but there is a large call especially in domestic work for toning in the other direction, toward the red and yellow. It is a comparatively easy matter to get, at a price, built-up shades to meet this requirement, but there is certainly an admirable chance for a line of well-designed decorative shades of moderate price to meet the special requirements of the very white and very bright modern lamp. The manufacturer who will specialize a little in this direction at the present time is likely to reap a very satisfactory reward. Suitable shades can be obtained by discriminating search but they ought to be so common an article of manufacture and carried so regularly in stock that the purchaser would find them ready to his hand. Plain bulbs dipped, and bulbs made of colored glass, are already coming into use and for certain purposes are quite sufficient, yet they hardly give the same result in softening of light as artistically designed fixtures.

Eminent Domain and Transmission Lines

When the laws relating to the manufacture, distribution and sale of gas and electricity were codified and extended in Massachusetts (Chap. 742, Acts of 1914), a new section (128) was introduced giving a limited power of eminent domain for the construction of transmission lines. As a condition precedent to the exercise of this power it had first to appear, after a public hearing, that the company had acquired rights in the public ways or over private lands for more than three-fourths of its length in the city or town through which it was to pass, and that the line was necessary and would serve the public convenience and be consistent with the public interest.

Experience in the administration of the law has developed a serious embarrassment in that a company has no occasion or even right to invoke the gas and electric light commission's authority until it has purchased or optioned not less than 75 per cent of the route and is held up by a few landowners with whom it cannot trade at all or upon reasonable terms. At this stage the commission is called upon to pass for the first time upon the questions which are fundamental to the exercise of eminent domain. In place of the present procedure the commission recommends to the 1917 Legislature that there should be first a preliminary hearing and decision upon the broad question of the public convenience and necessity to be served by the line. If this is decided affirmatively and the company is unable subsequently to acquire rights for the entire length of its line, further hearings and decisions as at present provided may then be had looking directly to the exercise of eminent domain.

MUNICIPAL PLANTS SHOULD SHARE COST OF REGULATION

Massachusetts Commission Also Recommends That All Managers of Municipal Plants Be Chosen from Civil Service List

Massachusetts municipalities operating lighting plants have from the outset been required to make annual returns to the Gas and Electric Light Commission and are subject to its specific authority with respect to certain features of their business. They are not required at present to share in the board's expenses, which have been entirely assessed upon the private companies under its supervision. Since municipal lighting plants were first acquired, states the commission in its recommendation for legislation just filed with the General Court, the board has been frequently called upon for interpretation of the municipal lighting law, and for advice as to accounts and the conduct of the business and still devotes an increasing amount of time to them. In view of their number and importance the Commission believes that the time has come when its expenses should be assessed upon municipal plants as well as upon the privately owned companies, and recommends legislation to this effect at the present session.

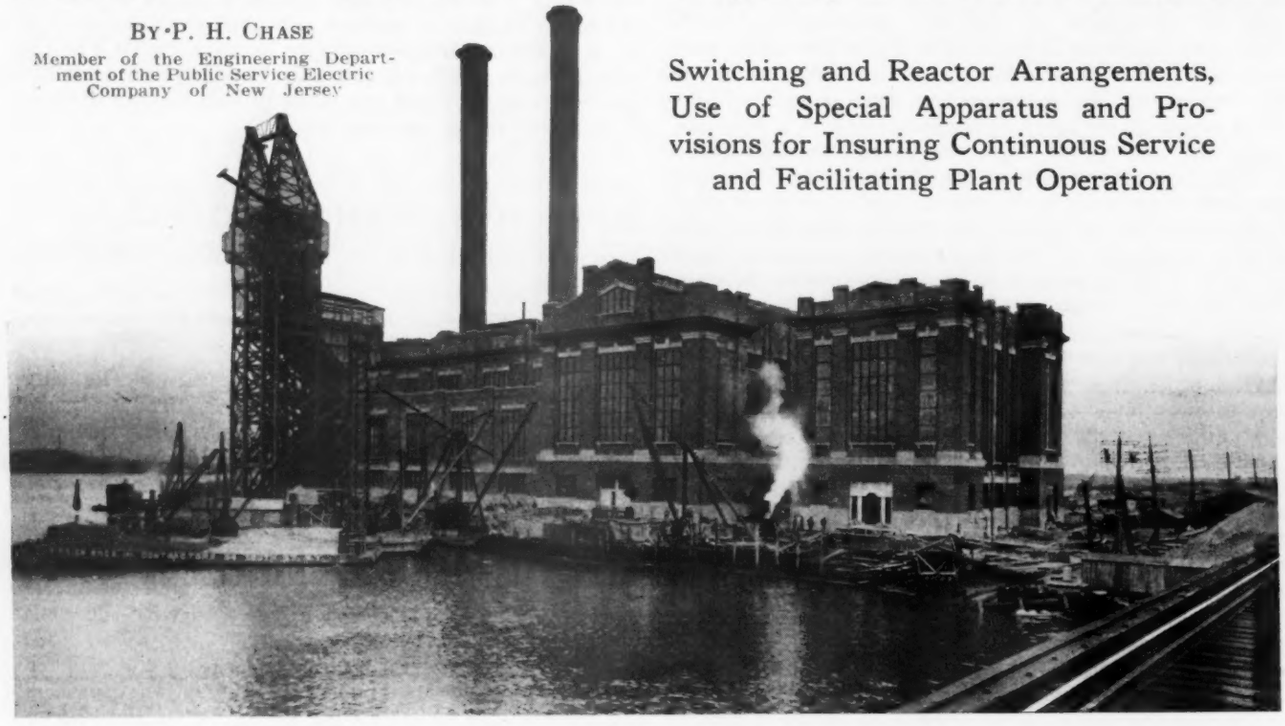
The commission has for many years regarded the existence of the power of a municipality to acquire a gas or electric plant, even though not exercised, an important aid to the effective public regulation of the privately owned companies under its supervision. In its recommendations the board points out that the value of this power is dependent upon the successful operation of such plants as have already been acquired by cities or towns. "One weakness which experience has developed is the insecure tenure of office of the managers of such plants, and the pressure which is frequently brought to bear upon them to permit or adopt practices with respect to the conduct of the business which will in time undermine the efficiency of such plants and the integrity of the public investment therein," states the report. The manager of the largest and most successful municipal plant in the commonwealth (Holyoke) was in 1915, by special act, put under the civil service laws to its distinct advantage. The board believes that the managers of all municipal lighting plants should be brought under the civil service.

The report further points out that any abandonment of public ownership once undertaken may seriously impair the value of the existence of the power in cities and towns to engage in the business of supplying gas and electricity as an aid in the proper regulation of gas and electric companies. Considerable headway has recently been made in two important instances (Concord and Westfield) in projects for the sale to privately owned companies of existing municipal plants. In two minor instances such sales have occurred. The commission recommends legislation prescribing the same careful and deliberate action in abandoning as in undertaking public ownership. Municipal plants have hitherto been restricted from supplying power to electric railways for car service, and the board recommends that this prohibition be nullified.

Features of New Jersey Company's Latest Station

By P. H. Chase
Member of the Engineering Department of the Public Service Electric Company of New Jersey

Switching and Reactor Arrangements, Use of Special Apparatus and Provisions for Insuring Continuous Service and Facilitating Plant Operation



THE new Essex station of the Public Service Electric Company of New Jersey embodies the most modern of construction features. Among these are the use of 25,000 kva. 1800 r.p.m. turbo-generators with direct-connected exciters, provisions for reclaiming heat lost in the electrical apparatus, switching methods to permit independent or parallel operation of generators, employment of synchronizing and feeder reactors, isolation of switch and control house from remainder of plant, arrangements for transferring control, extensive use of motor drive for auxiliaries, provisions for an uninterrupted supply of exciting energy and aluminum arresters on the generator fields. Other novel features which may be found at this plant are the elaborate indicating and recording boiler-room instruments, motor-operated steam and water valves, multi-recorders for indicating sequence of switch operations, faulty-cable localizers, high-tension testing apparatus, signalling system for auxiliary attendants, automatically indicating load-dispatcher board, and radial-type control system.

General Layout of Station

Essex station is located on the Passaic River about 2.5 miles east of Newark, N. J. This station had to be built to provide for present and future increases of both commercial and railway loads and to insure continuity of service with economy of operation. Of the available sites, the one selected was chosen because of its nearness to load, abundance of circulating water, convenient facilities for receiving coal by rail and water, and because of ample coal-storage space. Construction was started in 1914 and on Oct. 1, 1915, the first power was delivered from its generators.

The layout of the station will permit an ultimate installation of six generators. The first installation included two 25,000 kva. generators and four boilers, one generator being considered spare. In 1916, four additional boilers were installed, and orders were placed for a third generator of 35,000-kva. capacity and another set of four boilers to be installed in 1917. The coal-handling equipment is designed for an ultimate station capacity of 200,000 kva.

Of the ultimate station, one-third of the boiler house, one-half of the turbine room and one-half of the switch house are now constructed. This year the switch house will be extended to accommodate more out-going feeders, and the second section of the boiler house will be erected. The present boiler house is 166 ft. deep, 116 ft. wide and 106 ft. high; the turbine room is 90 ft. wide, 113 ft. high and 167 ft. long; and the switch house is 70 ft. wide, 95 ft. high and 117 ft. long, with six floors. Future extensions to the station will be made toward the south.

Since this article centers on the electrical features of the station, mention will be made of other equipment only when necessary for completeness or clearness. At the east river end of the boiler house is a coal tower which includes all equipment necessary for (1) unloading coal from railroad cars or river barges, crushing it to uniform size and conveying it to the coal bunkers located back of and adjoining the boiler house; for (2) unloading coal from railroad cars or river barges for storage in the coal yard; or for (3) reclaiming coal from the storage yard, crushing and conveying it to the coal bunkers. Chutes are provided in the outside coal bunkers, opposite the end of each firing aisle, so that coal may be brought into the building and distributed to the motor-driven stokers by means of 15-ton motor-driven weighing larries, one for each firing aisle.

The boilers are located on the main floor of the boiler house and are arranged four per row, with firing aisles at right angles to the center line of the turbine room. Below them in the basement are located ash-handling equipment, forced-draft blowers, boiler feed and miscellaneous pumps, piping and the power-distribution switchboard for the present section of the boiler house. Above the boilers are the economizers, one being provided for each boiler. Provision is made, as usual, for by-passing the flue gases. When the economizers are being used, the gases are drawn through them by motor-operated induced draft fans.

A wider turbine room than is usually employed in central stations was provided to allow the installation of generating units of 35,000 kva., without cramping the space required for assembling and repairs. A 100-ton electrically operated crane was also provided. Space was allowed at the north end of the turbine room for three 150-kw. motor-driven exciters, one of which is now installed. Under the turbine room is a basement, approximately 30 ft. high, containing the condensers, auxiliary apparatus and air-washing equipment for the generators.

Isolated from the rest of the station and standing to the west of the turbine room is the switch house, which contains six floors. A covered bridge connects the buildings. The southern part of the building contains the high-tension equipment, while the remainder is devoted to offices, station-power equipment, storage batteries and the control room.

Main Electrical Connections and Switching Arrangements

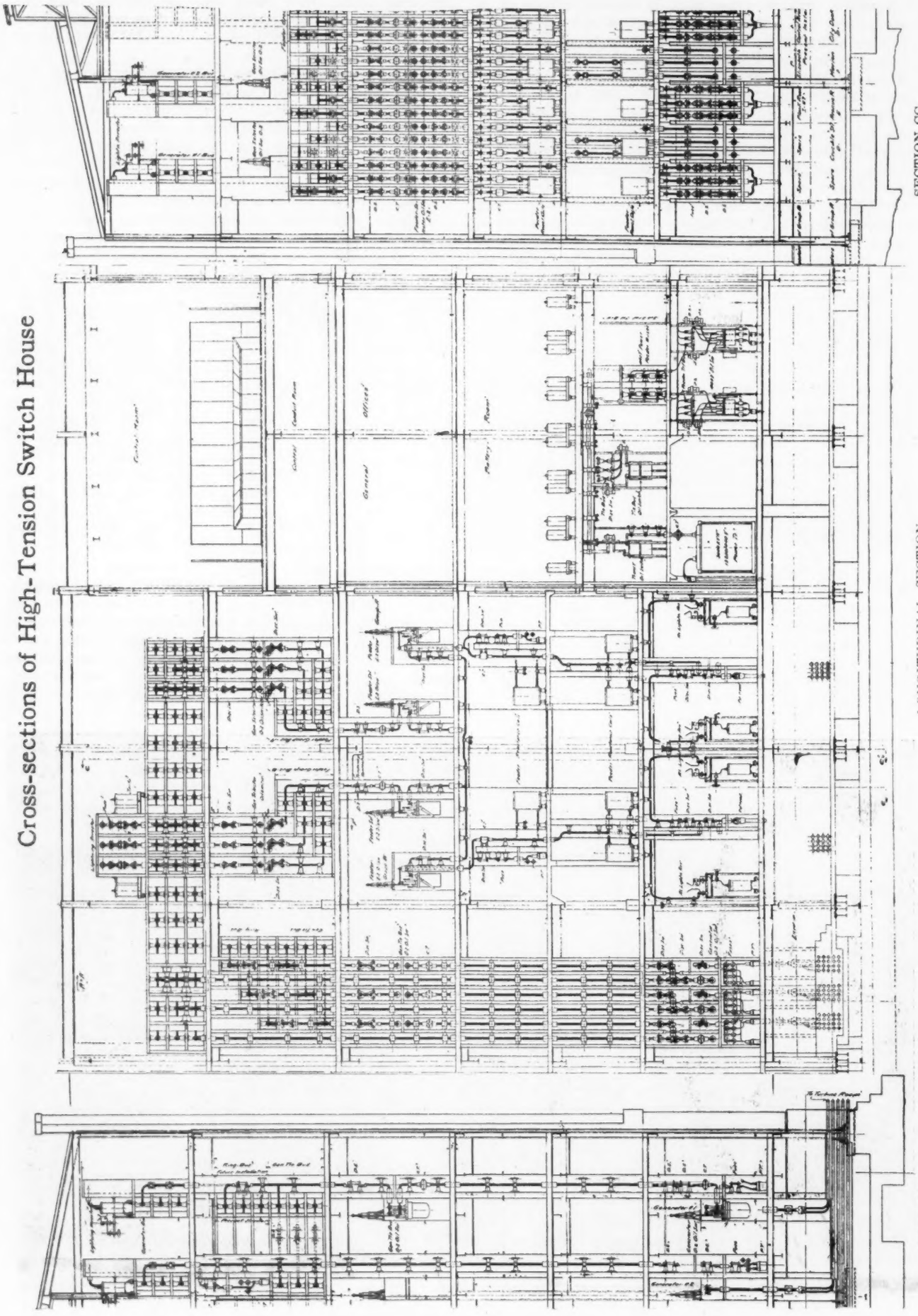
For the main electrical connections an adaptation of the old arc-board scheme has been adopted, since it affords very flexible operation. With this arrangement, which consists of one generator bus and one feeder group bus for each generator installed, any generator may be connected directly to any group of feeders. Eleven feeders will eventually be connected to each group bus. Oil switches are used between each generator, its respective bus and the tie bus, and also between each generator bus and group bus. In addition selector switches are provided so that each feeder may be connected to either of two group buses. Including the feeder oil switches, but not the ground suppressor oil switch which will be connected to the tie bus, there will thus be 180 high-tension oil switches required in the ultimate plant of six generators and sixty-six feeders, making 30 switches per generator. The relatively large number of oil switches is justified, however, by the ease with which loads may be shifted from one generator to another, individual feeders segregated for special operating conditions or test, and buses quickly cleared for repairs.

Reactors will be installed later between each generator and the tie bus for the following reasons: (1) To protect the generator windings, buses, connections and oil switches; (2) to help maintain service when a fault develops on one feeder; (3) to maintain service on all feeders when trouble occurs in any one of the generators, and (4) to secure protection while obtaining the several operating advantages of parallel operation. The particular connection selected for these reactors was chosen because it will permit using the minimum size reactors under given conditions of generator capacity, reactance and short-circuit protection. The general scheme of connections and the effect of the tie-bus reactors on short-circuit with grounds are shown in the diagram on page 128.

Reactors will also be used in each high-tension feeder, those connected with substations having 5 per cent reactance and those for tie feeders to other stations having 2.5 per cent. Since reactance is also inserted in the other ends of the tie feeders the total is the same as for feeders to substations. The effect of the tie-bus reactors is indicated by accompanying curves. These are based on six 25,000-kva. generators like those installed at present, carrying separate loads, and a short-circuit occurring on a generator bus or lead. With the particular value of reactance selected, therefore, the maximum short-circuit current will be within the rupturing capacity of the oil switches employed. The reactors will not be installed until the 35,000-kva. generator ordered for 1917 delivery is in place, since one of the two 25,000-kva. generators was intended originally as a reserve unit. As shown by the diagram of main electrical connections, disconnecting switches are inserted in the tie bus between each generator so any section may be repaired while the generators are tied together

TWO 25,000-KVA. TURBO-GENERATORS COMPRISING PRESENT STATION EQUIPMENT. A 35,000-KVA. UNIT IS BEING INSTALLED AND PROVISIONS ARE MADE FOR EXTENDING THE STATION TO ACCOMMODATE SIX GENERATORS HAVING A TOTAL RATING OF OVER 200,000 KVA.

Cross-sections of High-Tension Switch House



through the loop. Reverse-power relays protect the generator oil switches, overload relays with high time setting the tie-bus switches, time-element relays the feeder selector switches and radial feeders, and special relays the tie feeders. The generator selector switches are non-automatic.

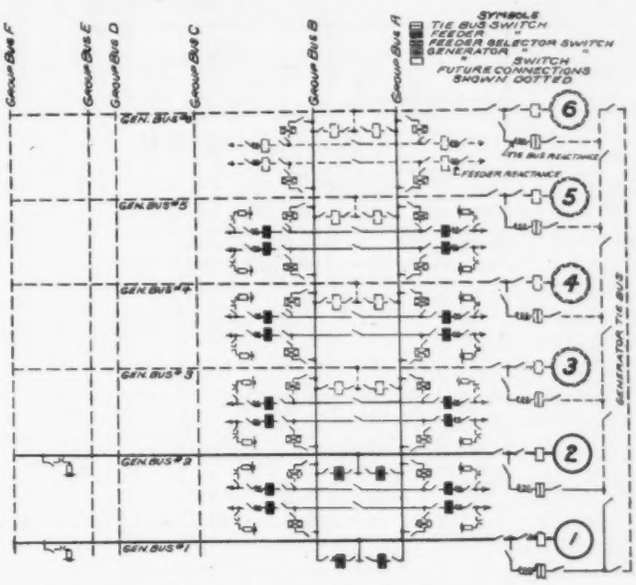
Since it was not considered necessary to have the switchboard operators see the turbines, the switch house was detached from the turbine room. This arrangement permits better lighting and ventilation, and minimizes the chance of serious trouble in the boiler or turbine room interfering with switchboard operation or load dispatching. The arrangement of apparatus in the switch house is shown in accompanying cross-sections and the wiring diagram in conjunction with these sectional views shows the course of circuits.

SWITCH STRUCTURES, CABLE AND WIRING

The various compartments, switch cells and bus structures in the station are constructed of special concrete brick, and are painted a battleship gray. For mounting the supports of the main leads and disconnecting switches, cast-iron inserts were built in these structures and also cast in the floors. For the generator leads and feeder selector leads cambric-insulated and braided copper tubing is used. The feeder connections are 350,000 circ. mil. cambric-insulated braided cable and the 13,200-volt buses are bare flat copper. Double supports are used for the buses and the generator leads to further safeguard these important parts of the main connections. Connections in the copper tubing are made by "shrink-fit" copper connectors to insure an absolutely reliable electrical and mechanical connection. The cables for the 440-volt power service and the main lighting feeders are cambric insulated and lead sheathed.

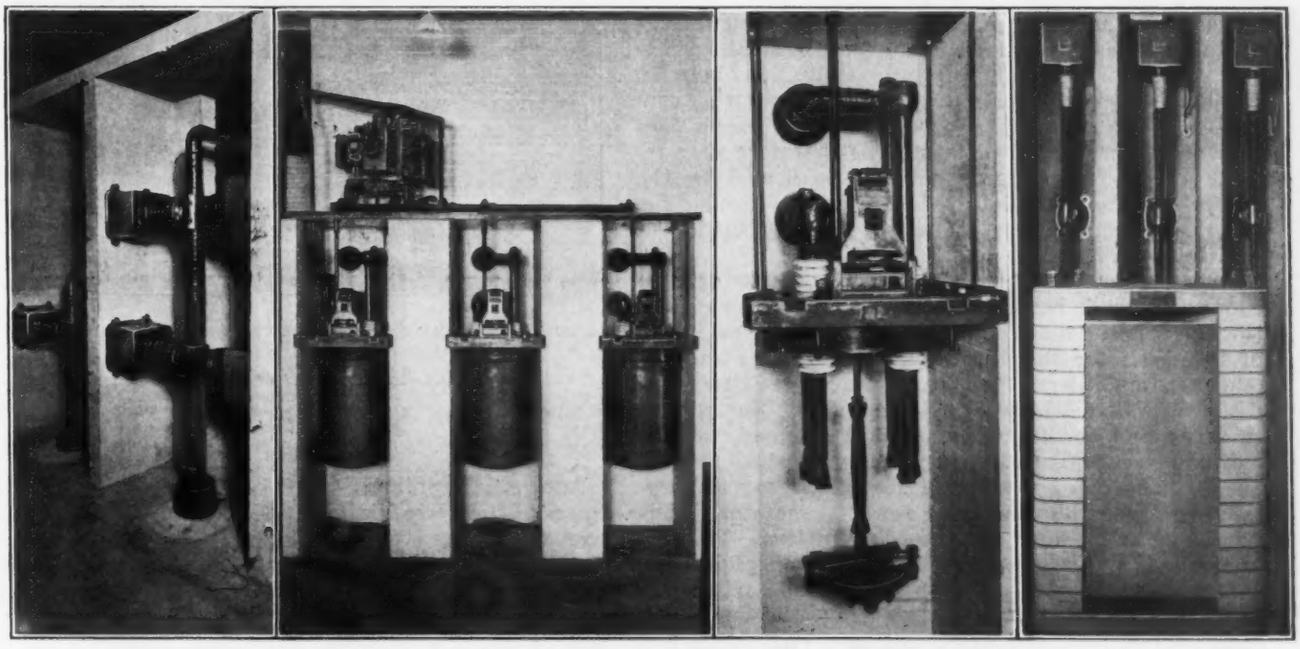
All of the automatic solenoid-operated oil switches are equipped with special "trip-free" relays which will not allow the oil switch to be held closed in case it has been closed on a short-circuit. This permits proper operation of overload and other protective relays with close time settings. The control cable for each oil switch is carried in a separate conduit from start to finish and the old type of common pull box has been abandoned. The 13,200-volt oil switches are mounted in concrete brick cells, with the operating solenoids above, while the 440-volt oil switches are mounted on pipe framework with the operating solenoids at the front of the switch. Every 13,200-volt and 440-volt disconnecting switch is equipped with a lock which prevents the switch being opened except by a switch hook.

In the present part of Essex station there is in the



CONNECTIONS OF GENERATORS WITH GROUP BUSES AND OUTGOING FEEDERS

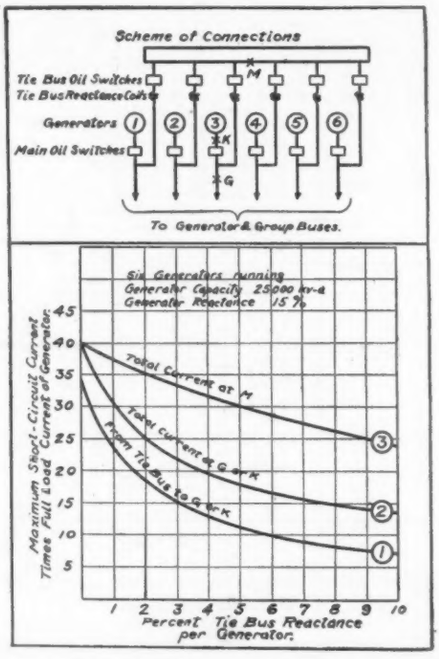
neighborhood of 250,000 ft. of conduit of all sizes. Most of it is of iron, although some brass was used for runs near or across single-conductor leads passing through floors and walls. Fiber conduit was used for the generator cables between the turbine room and switch-house basements. A large part of the lighting and control conduits in the boiler house are run exposed, but elsewhere conduits are carried largely in the floors and behind curtain walls. Many individual junction and pull boxes are installed to facilitate pulling cable and for protection between cables. On account of the large number of conduits and the necessity of properly identifying them while making up the conduit drawings,



BRACED GENERATOR LEAD, FEEDER OIL SWITCH AND FEEDER REACTOR

during construction, and for future additions, a numbering scheme was adopted.

Taking up the entire space on the fifth floor under the control room is a conduit room, where most of the conduits coming up the walls and in the floors are distributed to their proper destinations in the control room. It is believed this control conduit room is a



EFFECT OF TIE-BUS REACTORS ON SHORT-CIRCUIT CURRENTS WITH GROUNDS AS INDICATED

somewhat novel solution of the problem of properly distributing the conduits while providing for any changes that may be required in the future by expansion or changes in arrangement.

TYPE OF CONTROL SYSTEM USED

Particular attention was given to laying out the control system so it would be as reliable as possible and so any trouble could be localized, easily located and service restored immediately through the proper emergency connections.

To use a radial scheme of control distribution satisfactorily it has been necessary to resort to special relays and connections to avoid any inter-connections between the branch feeds of the system under all operating conditions. The chance that trouble on one branch feed may affect the rest of the system is therefore very remote. A 35-kw. charging set will be floated on the control battery continuously, but in case of trouble the control system may be connected to the 250-125-volt exciter battery leads.

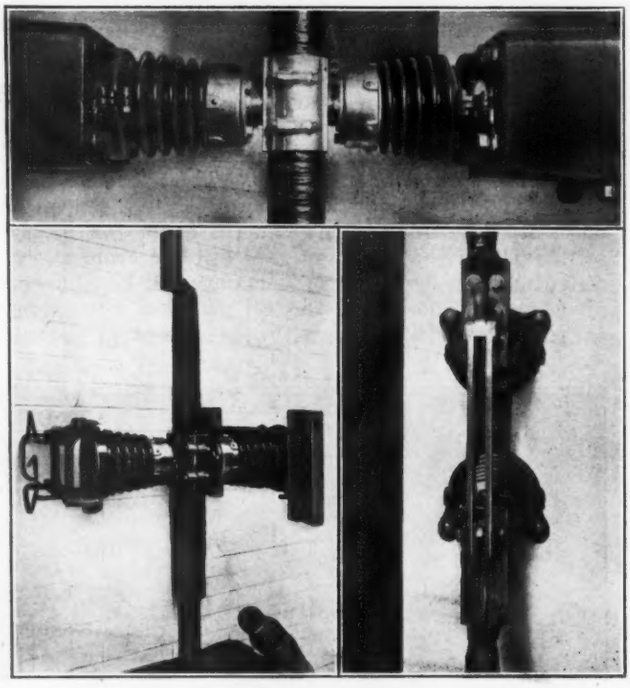
The control switchboards, which consist of two groups of three boards each, are arranged in curved rows on opposite sides of the operators' desk. One group of boards is for the generators and exciters and the other set for feeders. The boards nearest the operator's desk are of the bench type, and carry the control switches and indicating lamps. The second row of panels is vertical, and carries the indicating instruments. The third row of feeder panels carries protective relays, while the third row of generator panels carries curve-drawing and recording meters. This arrangement and segregation of panels simplifies the wiring on the boards and also permits all control and indicating equipment being seen from the operator's desk. While only part of the ultimate generating and feeder equipment is installed at present it was considered advisable to provide the complete switchboard equipment on account of wiring conditions and appearance of the boards. Vertical panels are installed at the sides of the control room for controlling the station power and lighting equipment and the multi-recorder and control batteries. Space is also provided for future generator-voltage-regulator panels.

On one of the vertical boards is a panel carrying a clock and two special synchronism indicators which are equipped with recording paper and an attachment for automatically moving the paper when a record is made. All the high-tension oil-switch control connections are so arranged that one of these synchronism indicators must be connected therein before the oil switch can be closed. Thus a record is obtained when each oil switch closes, showing whether it was closed at the correct instant. The synchronizing equipment throughout is in duplicate.

HIGH-TENSION TESTING EQUIPMENT

A high-tension set is provided for testing the outgoing high-tension cables. With it is used a 2500 kva. reactance with 75, 50 and 25 per cent taps, which will closely balance the capacity of high-tension cables of any size up to 350,000 c.m. and 15 miles in length at 30,000 volts, the 350-kva. testing transformer supplying the additional capacity. From the testing equipment a high-voltage lead is carried along the feeder compartments on the first floor and test connections are made to the cable at the pothead.

In another section of this article to appear in a following issue other features of this station will be described. It is of interest to note that the electrical layout of Essex station and all the electrical construction work, except the erection of the generators and storage batteries was made entirely by the engineering department of the Public Service Electric Company of New Jersey, no outside consulting engineers being employed in its design or construction.



METHODS OF BRACING HIGH-TENSION LEADS AND TYPE OF DISCONNECTING SWITCH USED

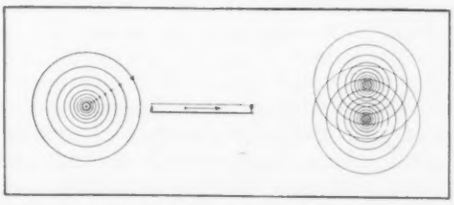
The construction shown in the top panel is used where the insulators can be attached to cell walls. Where this arrangement is impracticable one insulator is fastened to the back wall and the other placed on the open side of the cell wall and attached to brackets bolted to the barriers.

Fundamental Principles of Present-Day Transformer Design

How Different Arrangements of Coils Affect the Displacement Stresses in Transformers, Methods of Bracing Windings and Considerations in Favor of Moderate Reactance

BY W. M. MCCONAHEY AND J. F. PETERS

ALTHOUGH the induction coil which is the same in principle as the transformer was developed by Joseph Henry about 1830 nothing was done toward the development of the transformer until about fifty years later, when the question was taken up in England by Gaulard and Gibbs. Patents on core-type transformers were secured by these men in 1882. The following year the late William Stanley began an investigation of the subject for George Westinghouse and in 1885 designed shell-type transformers that had substantially the same form as many of those built to-day. In 1886 the Westinghouse Electric Company purchased the American rights of Gaulard and Gibbs and secured from them samples of transformers that they had built in England. During the same year the Westinghouse

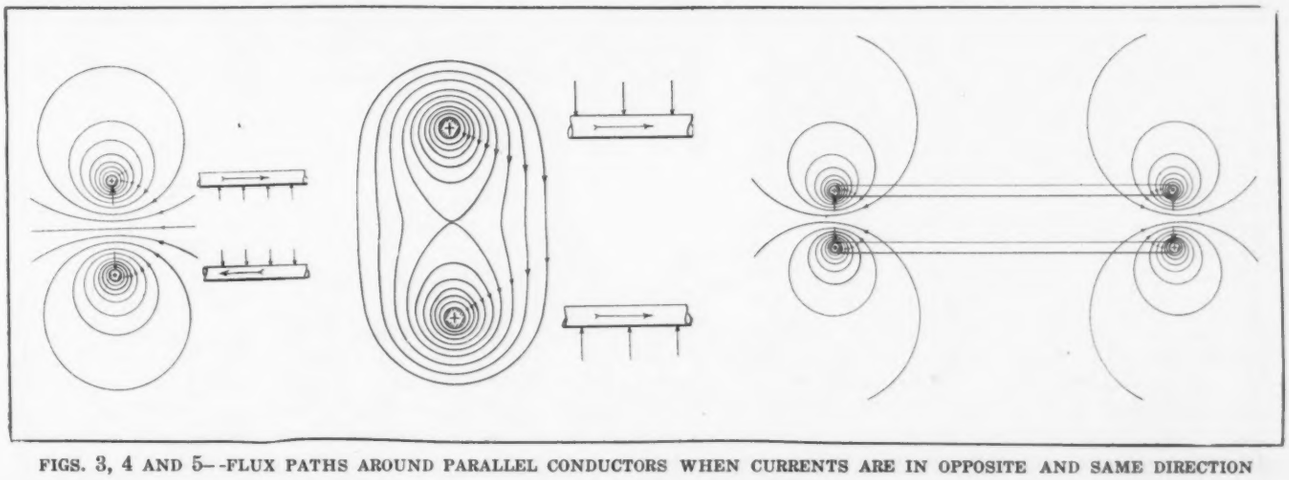


FIGS. 1 AND 2—MAGNETIC FIELDS AROUND SINGLE AND PARALLEL CONDUCTORS ASSUMING NO DISTORTION

company began the production of transformers for commercial use and from that time on there has been steady progress in the art. Ratings have increased from 2 or 3 kva. to 15,000 or 20,000 kva. and voltages from a few hundred to 150,000, but all this advance has been made in the short space of thirty years. Naturally, during this period many different forms of construction have been tried out, but, except for distributing transformers, the original simple forms of shell and core types, with modifications and improvements, have survived. Each of these types has its particular advantages under different conditions and careful designing engineers will consider the conditions involved before recommending a type for any specific service.

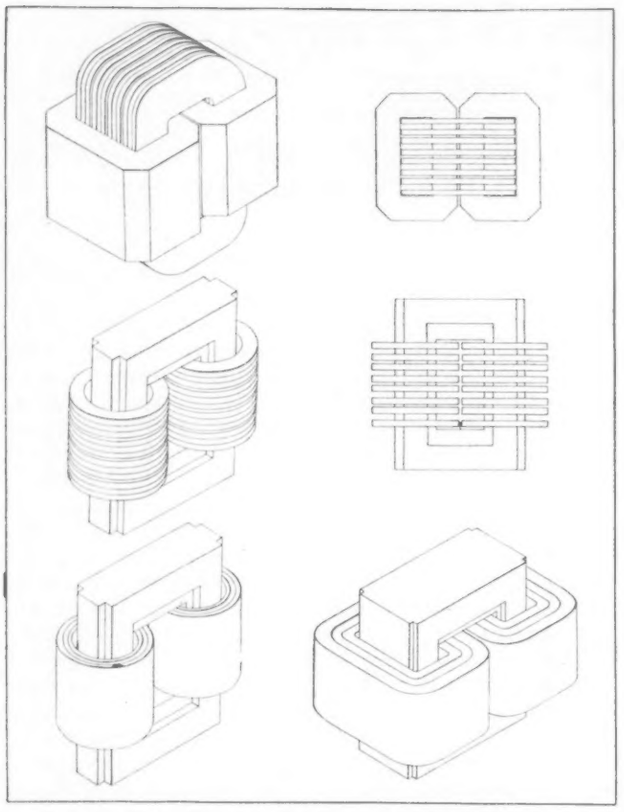
Some of the fundamental principles of design that apply to all types of transformers will be taken up in this article, particular attention being paid to the mechanical stresses that occur in the windings during short-circuit in the secondary system. To permit logically following the theory that applies to transformer operation it may be pointed out that a conductor, carrying either direct or alternating current, will produce a magnetic field like that shown in Fig. 1 if located in air or in any other non-magnetic medium and at a considerable distance from other current-carrying conductors or magnetic material. The field is in the form of concentric circles, its density at any point being directly proportional to the current flowing in the conductor and inverse proportional to the distance from the point to the conductor. If two conductors carrying current are brought close together, each will be subjected to the magnetic field surrounding the other, and if the two fields were not influenced by each other they would assume the paths in Fig. 2. Actually, however, the fields combine to form a resultant field, the shape of which depends upon the relative directions of the flow of current in the two conductors. With currents flowing in opposite directions the relation is as shown in Fig. 3. This field is in the form of eccentric circles and tends to produce mechanical repulsion between the conductors. When the currents are in the same directions (Fig. 4) the field tends to produce mechanical attraction between the conductors. The conditions illustrated are typical of those that exist in coils without iron, such as current-limiting reactors. Whether the force exists as repulsion or attraction its value is the same for any given current and separation of conductors.

Applying these relations to coils it can be seen that the conductors in one side of a coil attract each other, while those in opposite sides repel each other. However, when coils are assembled in groups in a transformer, the secondary ampere turns are equal and opposite to the primary ampere turns, so one side of a primary group will attract the opposite side of an adjacent secondary group, the net result being that the repelling and attracting forces between opposite sides



FIGS. 3, 4 AND 5—FLUX PATHS AROUND PARALLEL CONDUCTORS WHEN CURRENTS ARE IN OPPOSITE AND SAME DIRECTION

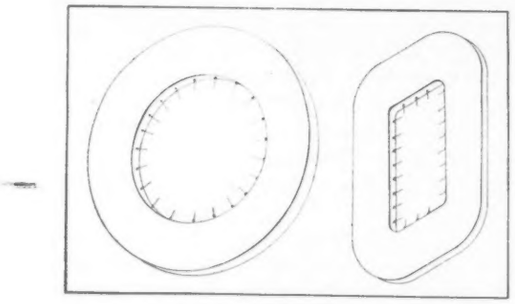
With currents through parallel conductors in opposite directions as shown in Fig. 3 the conductors repel each other while with currents in the same direction as in Fig. 4 attraction exists. Fig. 7 represents the flux paths around two adjacent primary and secondary coils showing repulsion.



FIGS. 6,. 6A, 7, 7A, 8 AND 9—FORMS OF WINDINGS ORDINARILY USED WITH CORE AND SHELL-TYPE TRANSFORMERS

practically balance each other. In other words, the repelling forces between opposite sides of a coil in a transformer under short circuit are negligible compared with the forces tending to force apart adjacent primary and secondary coils. By examining Fig. 5, showing the field around two adjacent primary and secondary coils of one turn each, it may be noted that the magnetic condition is similar to that shown in Fig. 3, and that it produces repulsion between the coils.

The forces of repulsion between primary and secondary coils under the short-circuit conditions depend upon several factors, chief among which are frequency, size, voltage and the amount of reactance in the circuit. These factors can be controlled to a large extent by carefully proportioning the design. The worst conditions are met in designing a large transformer for low frequency and low or moderate voltage to operate on a circuit of low impedance fed from a power house of very large rating compared with the size of the transformer. No matter what type of design is used, there are always adjacent groups of primary and secondary coils to repel each other, in case of short-circuit, so that the problem of bracing against these stresses is ever present. Short-circuit stresses can be calculated with a reasonable degree of accuracy, so that the suitability of any design, as regards mechanical strength,

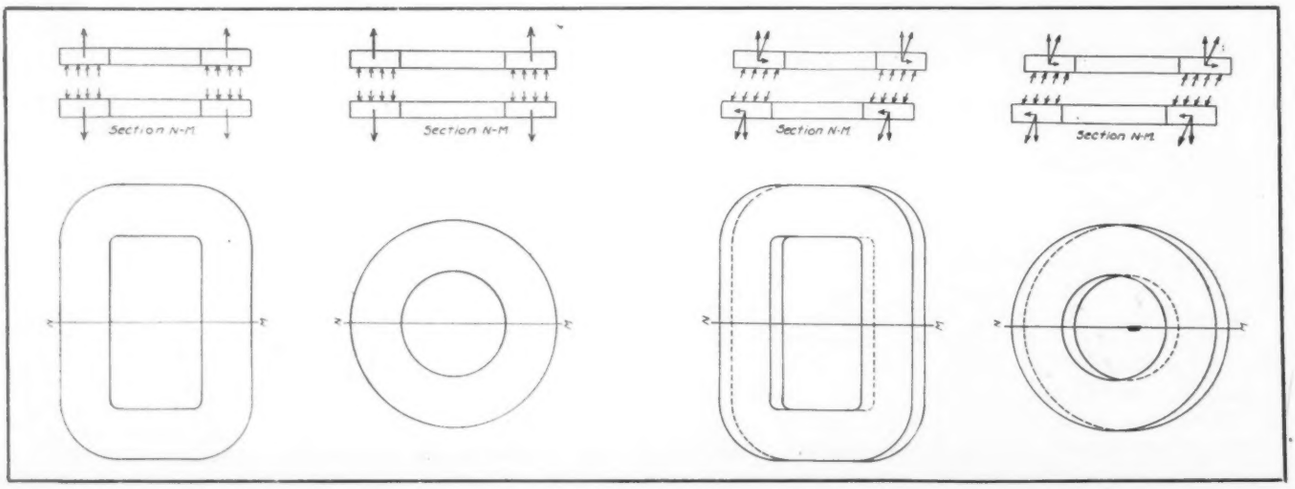


FIGS. 10 AND 11—FORCES ACTING ON ROUND AND RECTANGULAR COILS

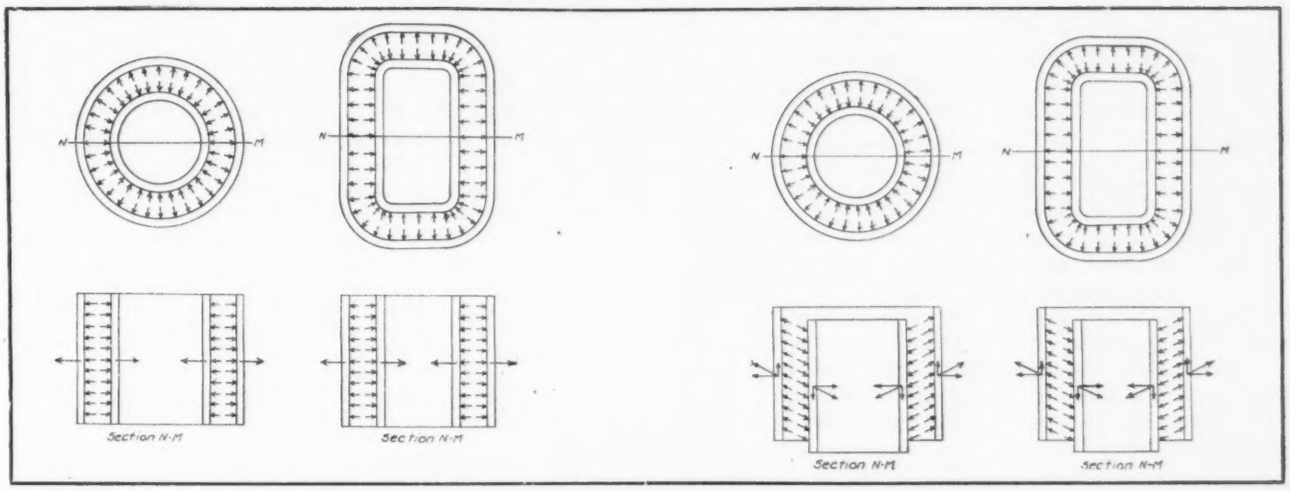
can be determined easily if the necessary service data are at hand. The amount and direction of the forces in different parts of the winding must be analyzed carefully, however, and all parts designed with such strength that mechanical distortion or damage cannot take place. In addition, careful attention must be paid to the relative positions of the groups of primary and secondary windings, as regards their electrical centers, since this relation has considerable influence on the distorting effect of the repulsive forces. By referring to Figs. 6, 7, 8 and 9, showing forms of windings ordinarily used with shell and core-type transformers, it should be evident that the problem of taking care of the short-circuit stresses does not differ materially with the two types.

When groups of flat primary and secondary coils having the same overall dimensions and identical electrical centers are used the magnetic forces act in the directions shown in Fig. 12. In this case the repelling forces are all at right angles to the planes of the coils. When the electrical centers are separated, however, there is a component of force parallel to the planes of the coils as well as at right angles to them, as shown in Fig. 13. The perpendicular component may be quite large, and in some cases sufficient to drive the coils apart with enough force to damage them.

With concentrically arranged primary and secondary



FIGS. 12 AND 13—FORCES EXERTED BETWEEN FLAT PRIMARY AND SECONDARY COILS WHEN THE ELECTRICAL CENTERS ARE IDENTICAL AND SEPARATED

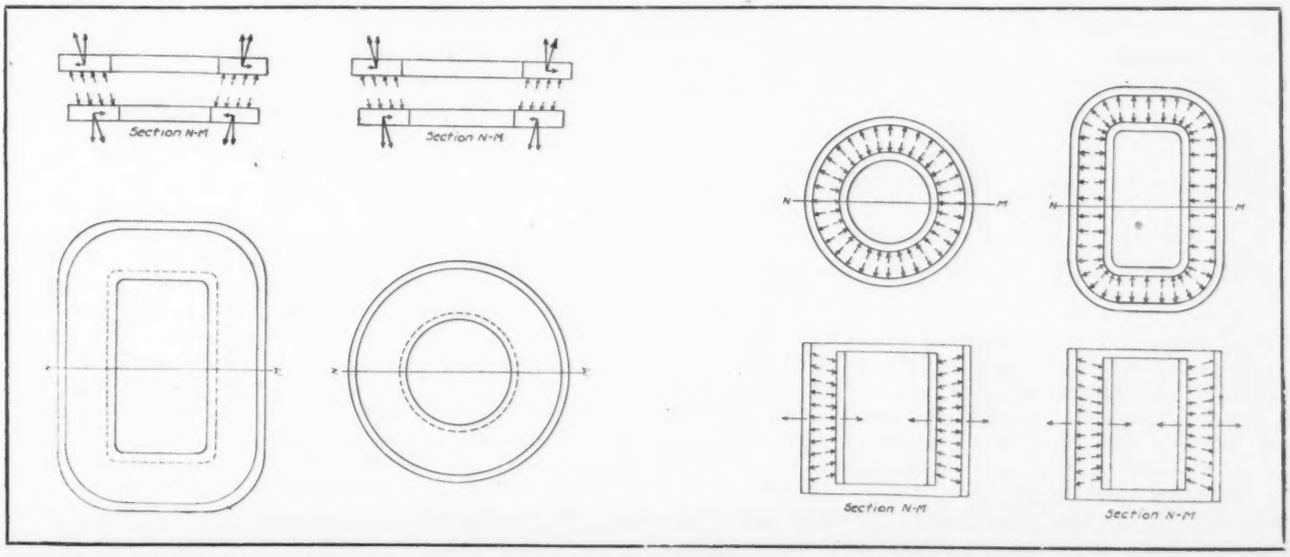


FIGS. 14 AND 15—FORCES EXERTED BETWEEN CONCENTRICALLY ARRANGED CYLINDRICAL PRIMARY AND SECONDARY COILS WHEN THE ELECTRICAL CENTERS ARE AND ARE NOT IDENTICAL

core-type windings whose electrical centers are in the same plane, the forces are at right angles to the axis or center line of the windings, as shown in Fig. 14, so they will not injure cylindrical or round coils. In large transformers wound with rectangular coils, however, the repulsive forces may be great enough to cause the coils to bulge out and tend to take a round or cylindrical form. For this reason rectangular coils are used only with comparatively small transformers of this class in which the forces of repulsion are small. When the electrical centers of concentrically arranged coils are not in the same plane, a magnetic component is produced parallel to the axis or center line of the coils. Even with a small displacement, this force may be very large, due to the fact that the primary and secondary windings are each arranged in one group per leg instead of being split into several smaller groups which are interleafed. The force is directly proportional to the product of the square of the ampere turns per group and the average length of the turns, and inversely proportional to the length of the magnetic leakage path between groups.

Since it is generally impracticable to employ a plurality of interlaced windings of the types shown in Figs. 14 and 15, in high-voltage transformers, due to the complications introduced in winding, insulating and bringing out leads, only one group of primary and one of secondary coils is employed on each leg in nearly all cases. With this arrangement the length of the leakage path between primary and secondary groups is comparatively long, but the square of the number of turns in a group is relatively very large, the net result being that, with a small relative displacement of windings, the short-circuit stresses may be very large. Furthermore, with the cylindrical or tubular form of coil, the surface afforded on the ends for bracing is very small, so that the short-circuit stresses per unit area may be very great and may be sufficient to cause the end turns to telescope and damage the coil. In practice it is difficult to assemble the primary and secondary windings so that their electrical centers are in exactly the same plane, this difficulty being increased when taps are brought out from the windings, as is generally the case. Slight variations in the thickness of ventilating spacers between flat or disk-shaped coils may also be sufficient to throw the electrical center off from the mechanical center enough to cause considerable stresses, even though the primary and secondary windings may be properly centered mechanically.

Fig. 16 shows the directions in which the magnetic forces act between groups of flat primary and secondary coils in which the groups are concentric with reference to one another, but one group has smaller dimensions than the other. In addition to the repelling forces at right angles to the planes of the coils, there are com-



FIGS. 16 AND 17—FORCES EXERTED BETWEEN FLAT AND CYLINDRICAL PRIMARY AND SECONDARY WINDINGS WHEN THE COILS HAVE DIFFERENT DIMENSIONS

ponents parallel to the planes which tend to force the sides of the smaller coils inward and the sides of the larger coils outward. With a large transformer these forces may be sufficient to damage the windings seriously. For this reason coils should be made to conform with a reasonable degree of closeness to the arrangement shown in Fig. 12.

During a short-circuit the repelling forces at right angles to the surfaces of the groups of primary and secondary coils in shell and interleafed core-type transformers may be a few pounds or several thousand pounds, depending upon conditions already stated. With shell-type transformers the parts of the coils within the iron core are held rigidly in place by the latter, so that movement cannot take place, while the ends outside the core are braced by heavy iron plates that are pressed tightly against the coils by means of tie bolts or pressure screws in the end frames. In interleaved core-type transformers the coils are braced by circular plates or rings, which are also held in place by tie bolts or pressure screws. So that forces in all directions, other than normal to the surfaces of the coils, will be negligible, care should be taken in winding and assembling the coils of either type to see that they are arranged in a manner similar to that shown in Fig. 12.

When one winding of a transformer with concentrically arranged primary and secondary coils has a greater axial length than the other, and the electrical centers are in the same plane, the magnetic forces act in the directions shown in Fig. 17. In this case there is a component of force parallel to the axis of the coils, which tends to drive the end turns of the longer winding outward and to compress or force together the turns of the shorter winding. Considering each winding separately, there is an attractive force between the turns due to the current in all of the turns flowing in the same direction. This force is sufficient to overcome the repelling force exerted by the shorter winding on the outer turns of the longer winding, except in case of extreme difference in length. When rectangular windings are used there is a tendency for the outer high-voltage coils to assume a cylindrical shape and for the inner low-voltage coils to press in toward the core.

The short-circuit stresses may be higher in the core-type transformers with concentric windings than in any other type. The high-voltage coils are braced in the same manner as the windings of an interleafed core-type transformer, while the cylindrical low-voltage coils are ordinarily braced by means of blocks pressing against their ends. These blocks must be arranged so as to provide adequate bracing and at the same time not interfere with ventilation. In all cases the characteristics of the design and the relative size and arrangement of the primary and secondary coils should be such as to keep all stresses within limits that can be controlled successfully.

Mechanical bracing as well as ventilation must be taken into consideration when deciding on the arrangement of ventilating spacers between transformer windings. Under certain conditions of short-circuit there may be a tendency in large transformers for the conductors of some of the coils to be forced out of place and into the ventilating ducts. Displacement is prevented in large shell-type transformers by using wave-shape spacers which insure good ventilation and practically uniform temperature. With disk-shaped core-type coils, spacers are arranged radially. This arrangement affords good mechanical support for the conductors, but it is not ideal for oil-cooled transformers so far as ventilation is concerned, because the planes of the coils are horizontal and therefore do not induce circulation of the oil. As a result the temperature of the coils increases from the inner and outer edges toward the mid-circumference. Full benefit is obtained from the temperature head in shell-type transformers since the spacers are placed vertical. Under ordinary conditions the rate of oil circulation does not exceed about 6 ft. per minute, so that the resistance to the flow due to the wave-shaped ventilating spacers is so small as to have an unappreciable effect upon the temperature. Generally, the difference in oil temperature at the top and bottom of the windings is about 6 deg. C. to 10 deg. C., whichever type of transformer is used.

Not many years ago transformer users were demanding units having low reactance because of the good regulation secured thereby. In many cases the reactance specified was so low that the designing engineer had trouble in securing it. With the increase in the number of large generating stations, however, transformer troubles increased due to the fact that the units were not strong enough mechanically to withstand short-circuit. Because of the low reactance the amount of current that flowed on short-circuit was so high as to make the mechanical stresses excessive. When this was finally realized there gradually developed a tendency to go to the other extreme and use transformers with quite high reactance. While reactance as high as 10 per cent may be desirable in a few cases, it is neither desirable nor necessary in a large majority of cases. Furthermore, it is by no means always true to say that the amount of reactance in a transformer is a measure of its ability to withstand short-circuit, since the reactance of transformer increases with increase in size, frequency and voltage, while the short-circuit stresses increase with size but decrease with increase in frequency and voltage. In most cases the short-circuit stresses can easily be kept within reasonable limits with a moderate amount of reactance. A large 60-cycle transformer of high voltage will naturally have comparatively high reactance and the short-circuit stresses will not be very great. On the other hand, a large 25-cycle transformer of medium or low voltage will naturally have comparatively low reactance and the short-circuit stresses will be high. Between these limits there is a wide field where transformers can be designed with a moderate amount of reactance and still have an ample margin of safety in mechanical strength under short-circuit.

A Potential Transformer for Direct Current

What purports to be a potential transformer for transforming low-tension direct current into corresponding high-tension direct current is the invention of P. M. J. Boucherot of Paris, France, patent No. 1,206,662. The process employed to accomplish this result may be summarized in three operations: (1.) First to transform the direct current into two or more alternating currents by means of a rotary commutator. (2.) Then to transform these alternating currents into other alternating currents of different emf. by means of ordinary static transformers. (3.) Finally to transform these new alternating currents into a direct current by means of a commutator rotating synchronously with the first. In reality, however, things are not as simple as might appear, for even when no current is taken from the terminals, the emf. between these terminals is far from uniform and heavy sparks are apt to be set up at the commutators. It is necessary, therefore, to add to the system some device which will furnish suitable excitation to the transformers, and therefore a small two-phase alternating exciter is mounted on the same shaft as the commutators, of which each phase is shunt connected to the primary or secondary of one of the transformers employed.

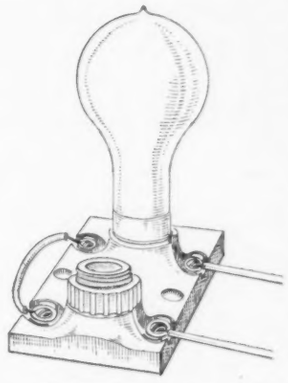
STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Temporary Arrangements for Serving High-Wattage Lamps

BY C. B. DEAN

Since the National Electrical Code does not permit connecting more than 660-watt loads with each cut-out on inside low-voltage systems, the writer has employed the arrangement illustrated herewith when high-wattage lamps must be installed temporarily. As shown two-receptacle cut-outs like Trumbull No. 2965 are used, the corresponding terminals of each socket being connected by a wire and the remaining terminals connected with the supply circuit. A fuse is placed in one receptacle and the high-wattage lamp in the other, thus protecting each individual lamp and permitting the connection of as many lamps as desired to the supply circuit. This arrangement can also be employed for serving heating appliances to avoid running separate circuits to them. In such a case, however, it would be advisable to place the fuse in the cutout next to the grounded circuit so the main fuse will be protected.



COMBINED CUT-OUT AND LAMP RECEPTACLE

Specifications of Kansas Company for Light Rural Transmission Lines

In Kansas a number of small towns of about 500 population are securing electric service by building transmission lines for themselves to larger neighboring cities in which central stations are operating. In such cases the smaller towns generally look to the engineers of the central station company for advice regarding line construction. C. A. Leland, Jr., electrical superintendent of the Atchison Railway & Light Company, has made up the following specifications for such cases.

LINE CONSTRUCTION FOR RURAL CIRCUITS OPERATED AT 6600 OR 13,200 VOLTS

Poles—White Cedar, minimum length 25 ft. with 6 in. top, spaced 140 ft. For road crossings 30 ft. poles should be used and at telephone and railroad crossings poles high enough to give 8 ft. clearance above other wires.

Cross-Arms—Standard electric light, two-pin arms with galvanized steel pins and standard hardware.

Insulators—Porcelain rated at 15,000 volts.

Pole Guying—Poles should be guyed wherever line changes direction more than 10 deg. At corners poles should be guyed both ways and have double arms.

Lightning Arresters—Westinghouse type S arresters or equal protection installed every 3 miles. Arresters should be grounded by means of 2-in. galvanized rods driven into ground.

Line Switches—Simple air-gap, fused switches should be used at line junctions.

Conductors—For voltages of 6600 or 13,200, No. 6 hard drawn, copper wire should be used. Transformers should have taps for raising the voltage when necessary.

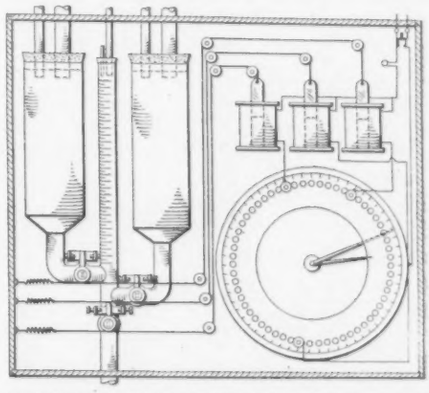
Single-phase, 6600-volt, or 13,200-volt, lines are considered more satisfactory than three-phase lines on account of the lower first cost.

In recommending these specifications under present conditions, Mr. Leland generally tells the prospective line builders that with the increased cost of copper the use of iron wire has come into vogue, although for the same conductivity this wire would cost as much at 6 cents per pound as copper wire would at 38 cents per pound, the conductivity of B.B. iron wire being 16 per cent that of hard-drawn copper. Since it takes several years to build up the load on a line it is often economical to install iron wire on lines built at present, expecting to replace the iron with copper when the load and price of copper justify it.

The cost of these rural lines was from $433 to $500 per mile in 1915, including all labor, material, lightning arresters and transformers at either end. This cost includes No. 6 bare copper wire at approximately 15 cents per pound. By using No. 6 B.B. iron wire instead of copper, the same type of transmission line could be built at approximately the same cost at present conductor prices.

Method for Continuously Testing Feed Water

Walter C. Raddant of Elia, Cuba, has recently developed and patented a device which is adapted to continuously and automatically testing liquids. It is being employed to good advantage for testing feed waters for boilers and the like, and for indicating the presence of sugar in boiler feed waters. This testing device has an improved form of time-controlled mechanism, so that it will test successively and automatically at predetermined intervals without attention other than to set the time-controlling mechanism at the desired time intervals. The glass liquid receiving tube with graduated marks shown in the accompanying illustration forms a mixing chamber. The larger pipe at the top of the tube is an



VERTICAL SECTIONAL VIEW THROUGH HOUSING SHOWING ARRANGEMENT OF PARTS OF LIQUID TESTING DEVICE

inlet pipe, the smaller, a vent pipe. The tube is extended downwardly to form an outlet conduit controllable by a turning plug valve arranged therein. The two containers on either side of the tube are formed of glass or other transparent material, these containers having outlet pipes connecting with the outlet pipe of the tube. The containers are intended to hold the re-

agents, the one on the left receiving a chemical indicator and the one on the right receiving the acid which is to be combined with the chemical indicator and the liquid to be tested. A pair of turning plug valves is interposed in the outlet pipes of the containers.

The time-controlled mechanism of this tester includes a plurality of electromagnets as shown in the illustration, these magnets being of the solenoid type and having movable cores. The cables are connected with the cores and trained over a plurality of sets of guide pulleys, the cables being convoluted about the valve stems of their respective valves, the grooves in the valve stems serving to accommodate the cables. The free ends of the cables are connected to coiled retractile springs for returning the valves to closed position after an actuation. The time-control mechanism includes an ordinary clock having the usual minute and hour hands, being specially modified to close the respective circuits of the electromagnets to energize the latter. The circuit-closing mechanism referred to includes an insulating ring member provided with a plurality of circumferentially arranged threaded openings spaced at intervals conforming to minutes or any desired intervals of time. The illustration clearly shows the electrical connection of the device.

In operation the liquid to be tested is supplied to the mixing tube. At a predetermined moment the minute hand will make contact with the first screw. This energizes the right-hand electromagnet, exerting a pull on the cable and the opening valve of the container on the left. This permits some of the chemical indicator to flow from the container to the mixing chamber. After a predetermined interval of time has elapsed the hand reaches the next contact screw, where the foregoing operation is repeated and the container on the right opens. When the hand reaches the third contact screw the operation is again repeated, the bottom valve opening. It is pointed out that the valves only remain open while the minute hand is in contact with the screws, the valves immediately closing by virtue of their respective retractile springs. However, the bottom valve remains open a sufficient time to permit all of the contents of the tube to flow through the outlet and permitting some of the incoming liquid to wash the tube before the valve closes.

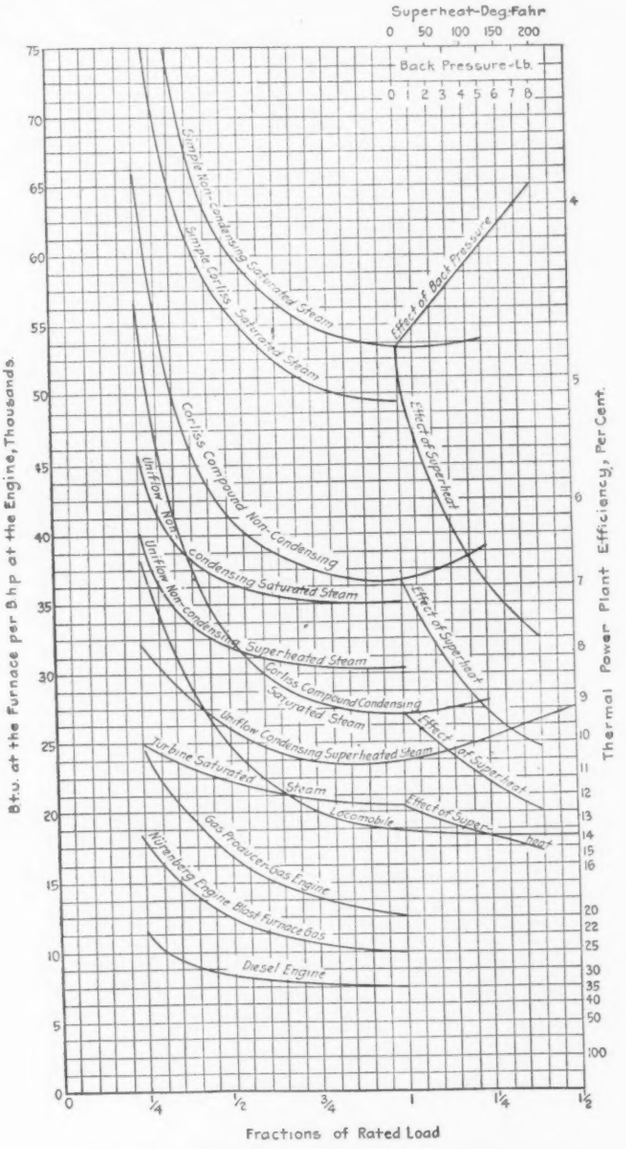
A Multiple Door Arrangement at Entrances to Air Ducts

To permit an entrance into the air ducts through which air passes to air-cooled transformers, reactances, and the like, it is usually the custom to build two doors, so that a person may enter without interfering with or interrupting the supply of air. If two doors were not used, with the area of the doors usually employed and at typical air pressures, it would usually be impossible and in any case difficult either to open the door or, if opened, to close it again. In many stations the doors leading into the air ducts are made of sufficient area to permit apparatus being taken in or out, which means that the doors are 25 or more feet in area. Even when two doors are installed with an intervening space between them for equalizing the air pressure, the opening of the doors, especially the interior one, becomes tiring and annoying where there is much traffic passing in and out of the duct.

A simple little arrangement has been installed in several instances which overcomes the need for exertion in opening the interior door. It consists of merely building into the interior door another smaller door with a handle which opens inward; that is to say, toward the interior of the duct and against the air pressure. If this small door has an area of 96 sq. in., or 12 by 8 in., or 0.75 sq. ft., and the air pressure is 0.75 lb. per square inch, this door can be opened with ease, whereas considerable effort would be required to open the main inner door, of perhaps 36 sq. ft. Opening the small interior door allows the air pressure to equalize in the space intervening outside and between the inner and outer doors. The small door acts as a small valve. It is best to install a small spring upon this small or pilot door so that it will close as soon as the hand is removed.

Relative Heat Consumptions of Various Prime Movers

The relative thermal efficiencies and unit heat consumptions of various types of prime movers are given in the accompanying chart presented recently before the A. S. M. E. by Victor J. Azbe. The ratings vary


Superheat-Deg. Fahr
0 50 100 150 200
Back Pressure-Lb.
0 1 2 3 4 5 6 7 8
Simple Non-Condensing Saturated Steam
Simple Corliss Saturated Steam
Effect of Back Pressure
Effect of Superheat
Corliss Compound Non-Condensing
Uniflow Non-condensing Saturated Steam
Uniflow Non-condensing Superheated Steam
Corliss Compound Condensing
Saturated Steam
Uniflow Condensing Superheated Steam
Turbine Saturated Steam
Locomobile
Gas Producer-Gas Engine
Nürnberg Engine Blast Furnace Gas
Diesel Engine
Btu. at the Furnace per B.hp. at the Engine, Thousands.
Thermal Power Plant Efficiency, Per Cent.
0 1/4 1/2 3/4 1 1 1/4 1 1/2
Fractions of Rated Load

UNIT HEAT CONSUMPTION OF PRIME MOVERS AT DIFFERENT LOADS

from 300 to 400 brake-horsepower, except for the simple non-condensing engine and locomobile, which were 150-hp. units, the turbine, which was rated at 4000 kw., and the gas engine, which was a 1200-hp. machine. In each case boiler efficiency was assumed to be 70 per cent, an

allowance of 3 per cent being made for the boiler feed pump and 2 per cent for leakage and condensation. For the condensing engines the auxiliary steam consumption was assumed to be 5 per cent of the total steam consumption. The temperature of the feed water entering the boiler was assumed to be 200 deg. Fahr., as heated by either exhaust or an economizer. For the uniflow engine, when operating non-condensing with superheated steam, the superheat was 120 deg. Fahr., and when operating condensing was 100 deg. Fahr., with 25.5 in. vacuum. The turbine tests represent performance with 28-in. vacuum, 175-lb. steam pressure and saturated steam. The locomobile curve represents tests with a varying high-pressure superheat of 80 deg. at one-fourth load to 235 deg. at one and one-fourth load and ordinary intermediate superheat.

Why a Motor Reversed Its Direction of Rotation on High Speed

BY R. L. HERVEY

A 2-hp. 220-volt direct-connected compound motor driving a band saw had been in service for approximately eighteen months without giving the slightest bit of trouble until the operator wanted to work the saw at its highest speed, which was obtained by using a field rheostat. When all of the resistance was cut in the field circuit the motor slowly came to a stop and started in the opposite direction. This was tried several times, and resulted in blowing the fuses most of the times. There could be but one condition that would cause this reversal of direction of rotation, namely, the compound winding being in opposition to the shunt field and overcoming it when the shunt field was weakened. By reversing the compound field leads the trouble was removed. This motor had been in operation for a year and a half without any indication of anything being wrong. The brushes and commutator were in excellent condition, which speaks well for the design of the machine.

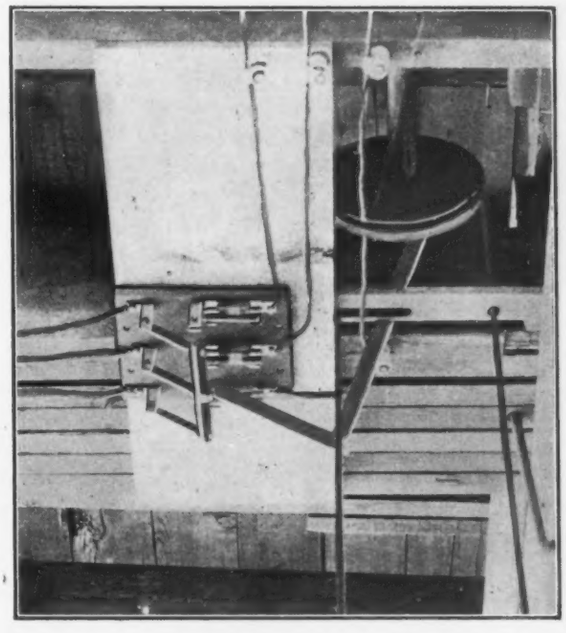
Results of Short-Circuit Tests on Oil Circuit Breakers

Recent tests of circuit breakers installed in a plant of large capacity, while not subjecting the breakers to the guaranteed limit of rupturing capacity, furnish an interesting demonstration of the ability of breakers to withstand successively severe operation without damage to the contacts. Sixteen short-circuit tests were made through the same breaker without the breaker being opened for change of arcing tips or examination of the state of the contacts. At the end of the test the breaker was opened for inspection, and there was no evidence on the arcing tips of excessive burning such as might be expected. The test was conducted by short-circuiting a 25,000-kva., 23,000-volt turbo-generator, five of them being made without external reactance in the test circuit. Five were made with 5 per cent 500 amp. reactance coils between the breaker and the short-circuit. The remaining tests were made by short-circuiting the circuits at a substation 7 or 8 miles distant, their circuit including about 3 miles of cable. In these latter tests the power stored in the combination of underground cable and overhead line probably represented a considerable increase in the kilovolt-ampere broken at the breaker contacts.

A series of tests were also conducted on another type of breaker rated at 25,000 volts, 600 amp., in which short-circuits having a root-mean-square value of 475,000 kva. at 24,500 volts, were repeatedly successfully interrupted, representing the largest amount of power which has ever been used under such a test. The generating apparatus was rated at 142,620 kva. The generator voltage was stepped up through a total transformer capacity of 90,500 kva., and oscillograph records were made of each test. The record of the most severe test showed that the short-circuit continued for six cycles on a 60-cycle circuit before the breaker contacts parted and continued for three cycles through the arc. This short-circuit, as well as the others, was opened by the breaker without difficulty, the same arcing contacts and oil being used in all the tests. There was no damage to the circuit breaker other than slight burning of the contacts and tank lining, which did not affect its continued successive operation. In the first series of tests Westinghouse type E-6 circuit breakers were used and in the second series Westinghouse type O-1 oil breakers.

Arrangement for Operating Ceiling Switch from the Floor

The arrangement shown herewith was devised so that the main line switch of a small alternating-current motor could be installed on the ceiling near the motor and still be operated from the floor. The switch-operating mechanism consists of a horizontal-shaft grooved pulley, near the rim of which is a pin carrying a link attached to the extended switch handle. Around the groove of the pulley and hanging down within reach



CEILING-MOUNTED MOTOR SWITCH THAT IS OPERATED FROM THE FLOOR BY ROPE

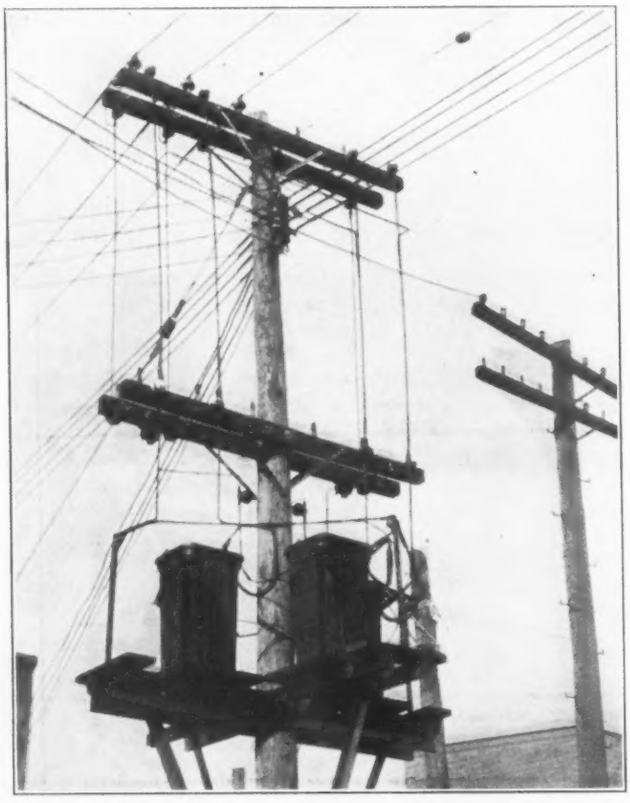
of the floor is a rope by means of which the pulley is revolved and the switch consequently opened or closed. Handles are provided on each end of the operating rope that hangs from the ceiling.

The operator who developed this idea points out that the switch can be made operable from several positions by extending the pulley shaft and placing grooved pulleys with operating ropes at intervals along the shaft. Aside from permitting simplified wiring the arrangement has the advantage that it does not hinder the movement of material around the shop in which it is installed as would rigid operating rods hanging from the ceiling.

Conveniently Arranged One-Pole, 75-Kva. Transformer Installation

Transformer installations such as shown in the accompanying illustration are employed by the Ohio Light & Power Company, Newark, Ohio, in alleys of congested districts, or in places where property owners object to a number of poles being set on their lots. Such an installation is capable of supporting three, or, if conditions should require it, four transformers of any size up to and including 25 kva. each. It possesses the further advantages of presenting a pleasing appearance and of being quite reasonable in price. The transformers may be placed at any height above the ground, and by increasing the size of the steel supporting members units even larger than 25 kva. may be so mounted.

The framework of the platform of these installations consists of channels and angle irons. Four 4-in. by 6.5-ft. channels are bolted into gains cut in the pole in the same fashion that gains are made for double buck arms. Besides the through bolts that hold the channels in



PLATFORM THAT CAN BE MOUNTED ON ONE POLE AND PROVIDES FOR FOUR TRANSFORMERS

place, four sets of space bolts are also used in each pair of channels to insure rigid construction and to hold the members parallel. The space bolts near the outer ends of the channels also hold the upper ends of the 2-in. by 2-in. by 0.25-in. angle-iron braces in place. The lower ends of these braces are secured by lag screws driven into the pole. On top of the pair of channels which occupies the lower gain, two sets of short 4-in. channels are fastened to bring the foundation of the platform into one horizontal plane. Pieces of 2-in. by 4-in. timber are bolted into the U's of the upper channels so that the platform planks can be nailed to them.

As a rule only three transformers are installed on such platforms. This leaves the fourth place for a man to stand while working on connections or fuses. It has also been found advisable to install double arms above the station to support primary and secondary leads. This practice allows neater construction and provides a convenient and safe mounting for fuses near the vacant side of the platform. An additional safety feature has been added by running the neutral wire around the edge of the platform on angle-iron standards to act as a platform railing. This installation was described by R. R. Krammes at a recent meeting of the transmission committee of the Ohio Electric Light Association.

Conclusions on Lightning Protection Arrangements

During the years 1915 and 1916 the Topeka (Kan.) Edison Company has followed the practice of installing lightning arresters on transformer poles, until now about 20 per cent of its transformers are so protected. From records covering the years 1912, 1913 and 1914 the average number of transformers burned out equaled 2 per cent of the total number in use. In 1915 and 1916, since changing the method of protection, the number of burnouts has been reduced to 0.44 per cent, or about one-fifth the previous amount. During the year 1916 the company has not experienced any cases of trouble at transformer installations protected by arresters on the same pole. This was probably due in part to few lightning storms during the year.

Direct-current meters appear to be especially susceptible to damage from lightning, and it is difficult to protect them, as they are natural discharge points owing to the direct path to ground afforded by the potential circuit. The number of direct-current wattmeters connected on the company's circuits has remained practically constant for the past five years, and during that time the cost per meter for repair parts has equaled 15.5 cents per year. The alternating-current meters show much better results. For the years 1912, 1913 and 1914 the cost for repair parts per meter averaged 1.3 cents per year. For 1915 the average cost was 1.26 cents. During 1916 this cost has been reduced to 0.83 cent per meter. These figures all show a noticeable improvement in conditions which the company feels is a result of the rearrangement of the protective devices on its system. Moreover, all outgoing 2300-volt, three-phase feeders and all 600-volt power and railway feeders are protected with aluminum-cell arresters and the interruptions of service caused by circuit breakers opening has been greatly reduced since they were installed.

From tests made over various portions of the distribution system and from general observation and experience J. E. Gossett, engineer of distribution for the Topeka Edison Company, reported before the recent meeting of the Kansas Public Utilities Association that his company has formed the following conclusions: First: Lightning arresters should be placed as near as possible to the device they are to protect. Second: Ground wires should be installed with the most direct path to ground, avoiding sharp bends or loops. A wire not smaller than No. 6 should be installed and if the secondary here exceeds this size a ground wire should be installed of the same size as the main. The ground wire should extend considerably below the surface of the ground unless the cross-section is increased. Third: Water-pipe grounds should be secured if possible; otherwise rods should be driven to a depth of from 6 to 8 ft. The greater depth will justify the additional expense. Smaller diameter and greater length produce better results at the same expenditure than rods of greater diameter with a corresponding decrease in length. Fourth: Rods should be placed about every 500 ft. or about every fifth span. Secondaries should be grounded as near transformer terminals as possible.

COMMERCIAL AND BUSINESS POLICY

A Department of Plans and Methods for Widening the Application of Electricity and for Extending Electric Service

THE SMALL-COMPANY EXECUTIVE AND NEW BUSINESS

A Plea That the Manager Interest Himself More Closely in the Work of His Commercial Aides, and Intensively Cultivate All Available Business

BY THE MANAGER OF A SMALL CENTRAL STATION

It is a regrettable fact that the selling methods employed by many small central stations are far less efficient and effective than are the selling methods used by merchants operating in the same territory.

The sole reason for this fact may be expressed in three words—"lack of competition." More often than one would imagine the manager or superintendent, who should be the leading spirit in the selling efforts of his company, busies himself in other matters of the company operation to the almost complete exclusion of new business. True, this official generally engages the services of one or more new-business solicitors, but proceeds quite promptly to permit them to drift pretty much for themselves. Generally, if more than two solicitors are engaged, one of them is given certain supervision authority over the others.

In this manner does the executive deliberately place a reducing valve between himself and the main artery of his company. The almost immediate resulting effect on the official himself is that his lack of contact with new business results in his failure to intelligently appreciate the new-business conditions of his company.

He quickly loses the ability to properly consider new-business problems. Those of his organization who handle the commercial work of his company are quick to appreciate his discomfiture upon taking up with him matters of their department. In consequence, it is only natural that the number of new-business problems presented to him are soon reduced to a minimum. Under these conditions, the matters of appliance purchasing and testing, advertising, special campaigns, etc., are not given the attention their importance should warrant.

Another result is a tendency towards a frequent change in salesmen. The ambitious ones are quick to see the advantages of associating themselves with other companies where there is a greater opportunity for learning. The unambitious ones accomplish little and soon drop out as a natural result.

Each salesman who leaves the company carries with him an investment which is in proportion to the length of time during which he has been an employee of the company.

The foregoing statement of conditions is not exaggerated, and is true to-day in some degree in a great number of small central stations. Larger central stations avoid this condition since they generally have a commercial manager of a caliber equal to the manager or superintendent of the smaller company. Since this commercial manager is employed solely for new-business work, the affairs of this department are, in consequence, placed in able hands.

Wherever in the business world the spur of competition is removed, the result is often that the business or the service suffers. Central-station managers should be keenly awake to this fact, and it should be their constant duty to see that the evils of this lack of competition do not in any degree overtake their companies.

How many small central-station managers can look into their consciences and answer that they personally know that the new business activities of their companies are as good as they could be? Let each ask himself if it would not be possible to turn over to some assistant purely routine work, and as a result gain sufficient time to permit his personal domination of the new-business work of his company.

There is scarcely a city or town in the United States in which there is not an attractive amount of new business to be had right under the nose of the central station simply for the proper going after it. This new business will never be found unless each central station manager believes it exists and makes plans to secure it.

With the present high cost of construction material, new business on existing lines has never been so valuable as at the present time.

Let us start the new year with the thought that we are proud of the fact that we are selling one of the few commodities which may be obtained at the old price and let us go out and get the necessary new business to make it possible to continue at the old price.

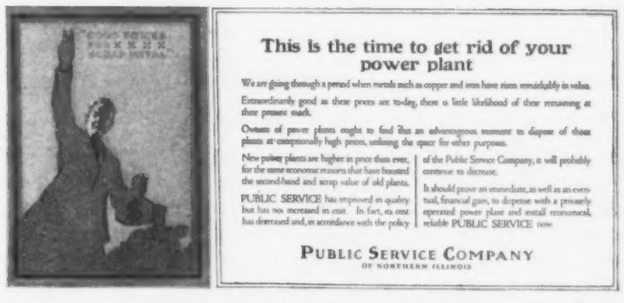
Electric Trucks in Government Printing Office Service

The United States government printing office at Washington, D. C., operates ten electric vehicles. Two of these are passenger cars, and the rest are of the commercial type. Of the latter class, two are of 1000-lb. capacity, two of 2000-lb., three of 5000-lb. and one of 8000-lb. The printing office also takes care of two "electrics" for the Post-Office Department and one for the Department of the Interior.

The following cost data refer to the printing office cars:

Weight of Car	Approximate Annual Miles	Yearly Cost of Operation
1,000 lb.	5,000	$550
2,000 lb.	6,000	$550
5,000 lb.	4,000 to 4,500	$600 to $700
8,000 lb.	3,500	$780

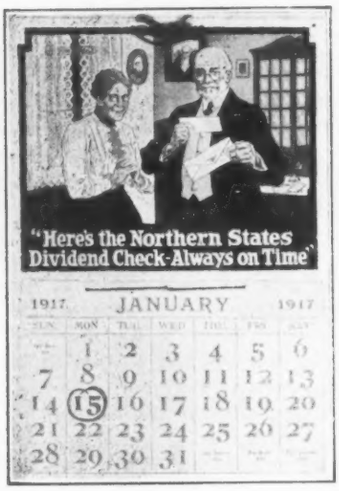
Taking Advantage of the High Price of Scrap Metal



In order to bring before the owners of privately operated power plants the excellent opportunity offered for the profitable disposal of their plants as a result of the present prices of scrap metal, the Public Service Company of Northern Illinois has issued this attractive three-color folder.

Advertising Prompt Dividend Payments to Sell Stock to Consumers

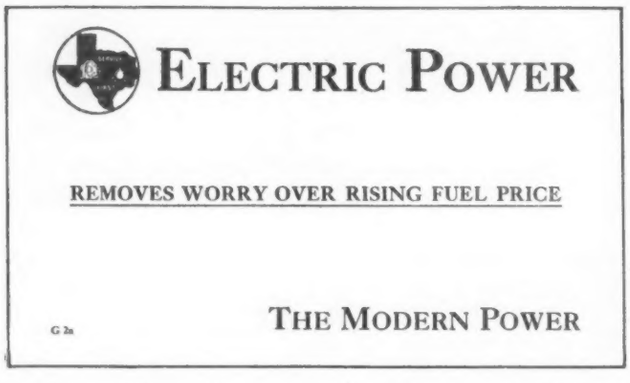
Another novel method of advertising its plan of selling Northern States Power Company's stock to consumers has been evolved by the publicity department of H. M. Byllesby & Company. Calendars like the one reproduced herewith will be distributed to customer-shareholders and to new purchasers of stock in home territory during the early part of 1917. The illustration on the calendar is one which appeared in one of the company's newspaper advertisements in the fall. The noticeable lack of advertising matter is intentional; since the calendars will be placed in the hands of only those owning stock, no elaborate explanation to them is necessary. Moreover, it is expected that the lack of a full explanation will cause non-owners who see the calendars to ask questions which will lead to a discussion of the stock and perhaps the sale of more shares. The red circles around Jan. 15, April 16, etc., indicate that these are "red-letter days" when the quarterly 1.75 per cent dividend will "always be on time."


"Here's the Northern States Dividend Check-Always on Time"
1917 JANUARY 1917
SUN MON TUE WED THU FRI SAT
1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28 29 30 31

CALENDAR DISTRIBUTED AMONG CUSTOMER HOLDERS OF STOCK IN THE NORTHERN STATES POWER COMPANY

The success of Byllesby company's effort to sell stock to consumers is considered remarkable. At the present time there are over 2000 customer-shareholders who own in excess of $1,100,000 worth of Northern States Power Company's preferred stock. Inauguration of the movement in other communities is being considered.

Fuel Prices Prove Potent Argument in Power Sales Campaign

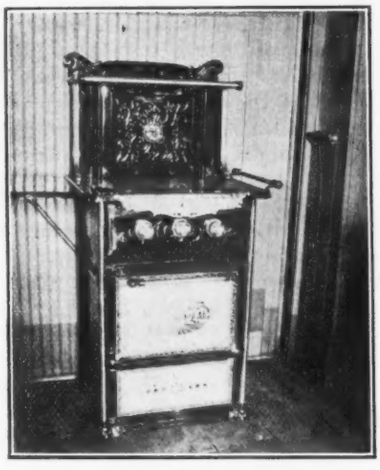


Pictured herewith is one of a set of postcards sent by the Texas Power & Light Company of Dallas, Tex., to cotton-gin prospects prior to the beginning of the present cotton season. There were six cards in this set, and they were included in a series of circular letters on the advantages of using electric power. A direct-by-mail campaign lasting sixteen weeks, during which time the prospects received at least one piece of mail matter each week, was productive of very good results.

Gasoline Stove Electrified at a Cost of Twenty Dollars

In order to get its customers started to "cooking by wire," the Otter Tail Power Company, with general offices at Fergus Falls, Minn., does some unusual things. For example, one customer who had been considered a prospective electric-range purchaser for a long time would not place his order on account of the price of the electric range. Being a mechanic he suggested having his old gasoline stove equipped electrically. At first the idea seemed impractical, but wishing to satisfy the customer if possible, C. B. Kidder, the company's general manager, sent a man to look over the old gasoline stove. He found that with a little work it could be made into an electric range at low cost.

From the stove—a Quick Meal, two-burner-and-oven type—the tank, all tubing, valves and burners were removed. This left nothing but a mere shell. The two



GASOLINE STOVE ELECTRIFIED BY ADDITION OF 3500 WATTS IN HOT PLATES

top burners were replaced with General Electric 8.5-in., 1000-watt, three-heat, sheath-wire hot plates; the oven was insulated with asbestos 1 in. thick, and was partially relined, leaving a small vent in the back; and one 1500-watt, three-heat, sheath-wire oven unit was placed in the bottom of the oven. All units were then fused separately and circuits leading to a porcelain connection block were connected through snap switches on the front of the stove. The stove was then enameled black. In this manner, with a few hours' work an old, nearly worn-out gasoline stove was transformed into a modern, cleaner and safer outfit.

The range was installed in the customer's home and has been giving satisfactory service. The customer was charged only for the actual cost of material, which amounted to $20. The result is that the customer was satisfied by getting an electric range at small outlay, and the Otter Tail Power Company has made this customer a greater source of revenue for central-station service.

Drying Fresh Ink Electrically

A Western central station company is furnishing energy for 250 heating units which are used to dry ink on freshly printed matter. The units are rated at 600 watts and are arranged on traveling conveyors, so that the intensity of heat upon the paper to be dried may be varied by raising or lowering the heating unit. Educating the printer in the value of such a drier leads to a profitable day load.

Revenue per Customer Increased by Appliance Load

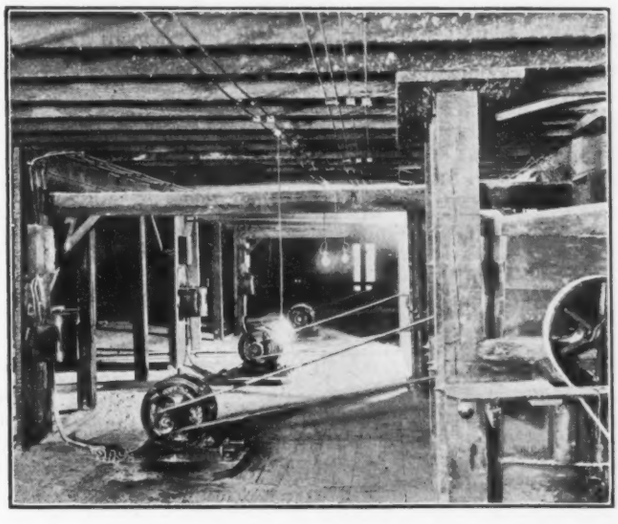
Prior to 1910, the central-station company at Youngstown was not actively engaged in selling current-consuming devices to its lighting customers, but lately it has taken store space in the most prominent location in the city. Evidence of the wisdom of this policy, according to C. E. Yacoll, the company's new business manager, is to be found in the fact that the company's revenue from residential customers has increased from $15 per customer in 1910, to $21 per customer in 1915. Moreover, while making this record the appliance sales department has been able to pay $500 a month rent in addition to all its other expenses and still "break even." It is the company's policy to sell appliances at list prices.

Loading Electric Trucks Inside the Building

A large New York City department store has been able to operate its electric trucks very efficiently by loading them inside its building. While gasoline cars, on account of insurance regulations, are compelled to load from the exterior of the building, this firm's electric delivery wagons actually go into the building proper, and through the agency of large elevators, are transported to various floors. There the wagons are loaded, thus saving expensive handling of packages. This method of handling the electric vehicle and its contents, which is permissible owing to the absence of fire hazard, is found to speed up deliveries considerably.

Motors Ten Years in Service Under Salt Works Conditions

A great deal has been said and written on the reliability of motor drive. Much of this discussion has, however, passed over the heads of non-technical readers and in spite of widespread educational work many power users still believe that the electric motor is not suitable for certain kinds under trying conditions of dust, moisture, and the like. A practical illustration of



MOTORS TEN YEARS IN CONTINUOUS SERVICE IN CLEVELAND SALT WORKS. WINDINGS AND PARTS ARE CAKED WITH THE SALINE DEPOSIT

the ability of motors to operate under severe conditions is the plant of the Cleveland (Ohio) Salt Works. The motors in this plant were furnished by the Lincoln Electric Company and have operated in rooms where moist salt is always present. This salt has caked into the windings, until they are hardly visible, as will be observed in the accompanying illustration. In spite of this there has not been a single shutdown from motor trouble in the ten years since the motors were installed.

This unique demonstration not only proves that the electric motor is a most reliable piece of apparatus, but shows that expensive protection is not always necessary against even severe moisture and dust conditions.

Mixing Lamp Tints

To make the lighting in its store conform to a general color scheme that was being worked out, the Merchants Heat & Light Company at Indianapolis, Ind., recently wished to give lamps which were to be mounted

DISPLAY ROOM AT INDIANAPOLIS DECORATED WITH ORNAMENTAL POST STANDARDS BEARING RUBY LAMPS

in some street lighting standards an "old-rose" tint. A red dip was the nearest color obtainable. An endeavor was made to thin the red with alcohol, then with lacquer, then with water. In each instance the result was a red jelly, not an old-rose liquid. Then mixing two different colored lamp dips of the same make was tried. They also jellied. Finally by mixing a quart of lamp frosting and 0.5 pt. of ruby lamp dip, a beautiful old-rose coloring was obtained. Later it was learned that the red coloring could have been thinned with ether. The result of mixing the frosting and the ruby coloring, however, left nothing to be desired and the lamps when inserted inside the diffusing globes, produced an old-rose shade that cleverly matched the old-rose cloth coverings on the ceiling units.

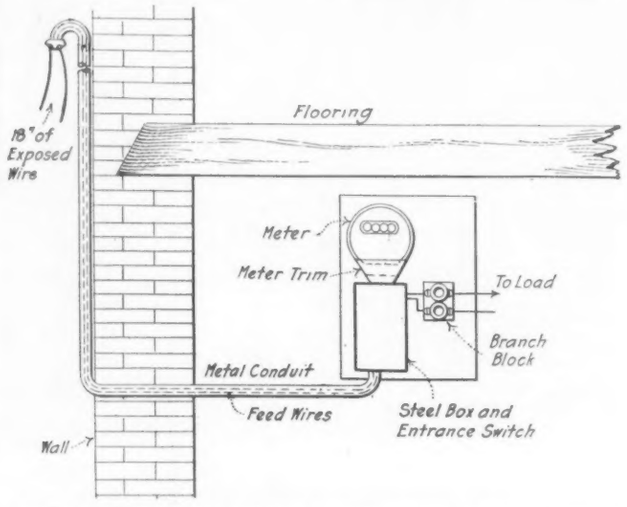
Two-Thirds of Irons Found in Regular Use Six Months After Purchase

Some managers have questioned whether the sale of a large number of devices, especially irons, really indicates that more than a very small percentage of them are actually kept in use.

"There was one Southern city," said Frank Hammond, the general agent of the Birmingham (Ala.) Railway & Light Company, before the Southeastern Section, N. E. L. A., "which put on a special sale of irons and disposed of 350, and the addresses of 290 buyers were placed on file. Six months later a canvass of these 290 consumers was made, and it was found that 63 per cent of these irons were in use on an average of two hours per week. The other 37 per cent had either moved or the iron was stored away."

Specifications for Meter Installation Adopted by Illinois Company

The Canton (Ill.) Gas & Electric Company has been experiencing considerable difficulty through thefts of energy on the part of persons by-passing meters. On this account the company has just issued a new set of specifications covering the installation of meters and the connection of service wires. These specifications provide for the installation of the meters in inside cellarways or basements. If these places are unfit for placing the meter, provision is made for its installation in the kitchen. Each meter is to be hung on an asbestos-covered board in a position which will be accessible to the meter reader with the least annoyance to the customer. In no instance is the meter to be placed more than 7 ft. above the floor. The fact that the State Public Utilities Commission requires frequent testing of watt-hour meters has caused the company to specify also that a meter must be installed with sufficient space around it to enable the meter tester to do his work in a satisfactory manner. The specification also states that a service cut-out and main line fuse shall be installed on the line side of the meter inclosed in a locked iron box and that a meter trim shall be placed between the meter and the box so that there will be no exposed wires between the meter and the service cut-out. All wiring from the service cut-out to the outside of the building must be placed in conduit. No wire smaller than No. 12 is to be used for feed wires between the outside of the building and the service cut-out. The illustration herewith shows a typical installation under these specifications.



SKETCH SHOWING APPROVED METER INSTALLATION PROOF AGAINST TAMPERING

Putting on a Successful Electrical Show in a Town of 8000

An electrical show that was run for one week at a total cost of 17 cents per visitor was put on during America's Electrical Week by the Rumford Falls (Me.) Light & Water Company.

After renting a vacant hall the company set up a framework to represent a living room, dining room, kitchen and bath room. The rooms were supplied with furniture, rugs and portieres by a furniture dealer, and the kitchen and bath room were fitted up by a local plumbing firm. Tea and coffee were supplied by an importing company of Rumford, and the light company installed complete electrical equipment throughout.

An experienced woman demonstrator was employed. She made it a point to show the visitors how the various appliances performed during actual working conditions.

Data on Small-Town Electric Service

C. A. Leland, Jr., superintendent of the electrical department of the Atchison (Kan.) Railway & Light Company, speaking before the Kansas Public Service Association, presented statistics which, he said, had proved valuable to him in securing transmission line business from small towns. These data were collected during an investigation of about fifteen small towns.

The maximum demand per capita averaged 37 watts. There was one residence to each 3.5 of population. The gross earnings per capita during the first year a town is served averaged $2.50. This increased about 10 per cent per year and sometimes reached as much as $7 per capita. The line and transformer loss varied from 20 to 33 per cent. The distribution loss usually amounted to about 10 per cent where no transformers were used, and 25 per cent where distribution transformers were used. Gross earnings per meter averaged from $20 to $28 per year.

The earnings on all classes of this service increased more rapidly than the earnings in the near-by larger city of Atchison, although practically no effort was made to increase the small-town business, and there was a continual appliance and house-wiring campaign in the city.

How a Michigan Central Station Lives Up to Its Service Slogan

The Consumers Power Company of Owosso, Mich., features its slogan as widely as possible. The phrase which it has taken as its text is worded:

"Always—AT YOUR SERVICE—All Ways"

"Service" is a broad-gage word, but the company uses no limiting adjectives. Recently the principal of a local school asked the firm for complete data on the number of employees and their earnings in a given industry between 1909 and 1914. The information was furnished promptly, much to the satisfaction of the school director.

A short time later a debate was scheduled in the Owosso high school on the subject: "Resolved, That the City of Owosso Should Own and Operate Its Electric Light Plant." The principal for whom the company had secured the above-mentioned data, suggested that the students having the negative side call at the power company's office for material.

Naturally the company's slogan was again justified and the debaters were given arguments galore. The negative side scored a decisive victory, and as it happened that the leader of that team was the daughter of the Mayor, and succeeded in convincing her father of the value of independent plant operation, the company felt well paid for its trouble.

Recently the company received a request for data on the value of products manufactured from 1909 to 1914 and the capital required to handle the industries of the United States during that period. The request was promptly complied with, as was one from the business men's association for storage room for some banners that are in use for a short time each year. The policy of diversified service is claimed by the company to be steadily building good will for it.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

TUNGSTEN FOR BATTERIES

Electrolytic Behavior of Tungsten, and Its Possible Use in Standard Cells and in Storage Batteries

TUNGSTEN has become a very important metal in recent years. The bulk of tungsten produced now goes into the steel industry for the manufacture of special tool steels, with the percentage of tungsten as yet used in the electrical industries almost insignificant when compared with the total production. The industrial importance of the electrical uses of tungsten is nevertheless very great. First of importance is the tungsten lamp, with various minor electrical uses like tungsten wire and ribbon for resistors in electric furnaces or heating apparatus. The possible minor electrical applications of tungsten are numerous. One particular field that has been little investigated, the electrolytic behavior of tungsten, is treated fully in a paper by Walter E. Koerner, presented at the last New York meeting of the American Electrochemical Society and published in *Metallurgical & Chemical Engineering* of Jan. 1, 1917. It gives the results of an extensive investigation carried out by the author under the direction of Dr. C. G. Fink in the research laboratory of the Edison Lamp Works, Harrison, N. J.

The researches covered three distinct fields. First the author determined the single potentials of tungsten and tungsten oxide in various electrolytes, with a view of obtaining some light on the relative solubility of tungsten in those electrolytes.

Second, the anodic behavior of tungsten and its passivity were studied. The conditions under which tungsten as an anode becomes passive were investigated and it was found that the passivity of tungsten is due to adherent films of hydrated tungsten oxides. These hydrated films appearing on the anode vary in color from brown through blue to yellow. The degree of passivity varies with the color of the film. The films may be readily dissolved and the passivity of the metal thereby destroyed.

The third field investigated, and possibly the one of most direct present interest from a practical viewpoint, is the use of tungsten in cells.

For the construction of a voltaic cell with tungsten as negative electrode it is desirable to use an electrolyte in which both the tungsten and the anodic reaction products are most soluble. With a sodium hydroxide solution as electrolyte mercury or silver may be used as positive electrode against tungsten as negative electrode. The emf. of such a combination using mercury is 0.49 volt, with silver 0.69 volt. Preliminary experiments with tungsten both as fused slugs and as metal powder were promising, especially those with the metal powder. Another series of experiments was made and is still being continued on the use of tungsten in standard cells.

Finally some rather interesting tests were made on the possible use of tungsten in storage batteries, using combinations of tungsten and tungsten oxides. Three types of cells *A*, *B*, *C* (Table I) were studied.

Cell *A* had tungsten and tungstic acid as the positive electrode and tungsten metal as the negative before charging. Cell *B* had tungsten and tungstic acid as both electrodes, while cell *C* had tungsten-tungstic acid as negative electrode and tungsten as positive, being the reverse of *A*, before charging. The cells were connected in series and charged. The emf. of *each* cell was measured immediately after charging and found to be 3 volts for cell *A*, 3.20 volts for cell *B*, and 6.20 volts for cell *C*. Twenty-four hours after charging the cells, the emf. had dropped to 0.2 volt, 0.55 volt and 0.85 volt respectively. The cell *C* having $W|WO_2$ as positive electrode and $W|W_2O_5$ as negative electrode has so far been the most satisfactory.

The results obtained with the tungsten storage batteries look rather promising.

TABLE I—BEFORE CHARGING

Type	Positive Electrode	Negative Electrode	Emf.
A	$W\|WO_2.\ xH_2O$	*W*	+0.08
B	$W\|WO_2.\ xH_2O$	$WO_2.\ xH_2O\|W$	0
C	*W*	$WO_2.\ xH_2O\|W$	−0.08

TABLE II—AFTER CHARGING

Type	Positive Electrode	Negative Electrode	After Charging, Emf.	Twenty-four Hours After Charging, Emf.
A	$W/WO_2.\ xH_2O$	*W*	Volts +3.00	Volts +0.2
B	$W/WO_2.\ xH_2O$	Blue $W/W_2O_5.\ zH_2O$	+3.20	+0.55
C	Brown $W/WO_2.\ yH_2O$	Blue $W/W_2O_5.\ zH_2O$	+6.20	+0.85

Generators, Motors and Transformers

Burning Out of One Transformer of Two in Parallel. —A concise discussion of a case in which two identical

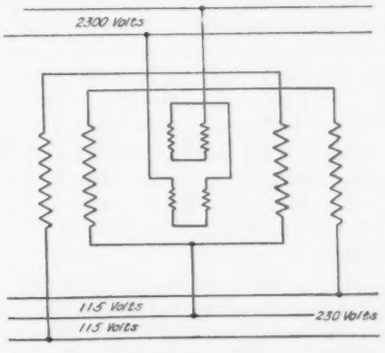


FIG. 1—THREE-WIRE TRANSFORMERS CONNECTED IN PARALLEL

three-wire transformers were mounted on a pole and connected in parallel, according to Fig. 1. One of them burned out. That the two combined were not overloaded was later demonstrated by the remaining transformer carrying the entire load satisfactorily. What was the probable cause of the burnout? It is pointed out that with identical transformers having properly

balanced windings successful parallel operation should be obtained with the connections shown in Fig. 1, unless there was some defect in one or both machines. If the machine was not defective a possible cause of the burnout may have been an imperfectly balanced design, resulting in an unbalanced heating or three-wire load. The wiring diagram of a transformer having

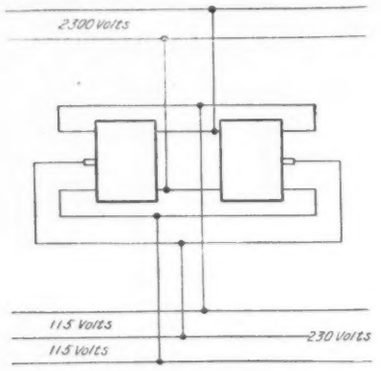


FIG. 2—THREE-WIRE TRANSFORMERS WITH BALANCED WINDINGS

balanced windings is shown in Fig. 2. This transformer will maintain a uniform heating on either balanced or unbalanced three-wire load. In it both halves of the secondary winding are distributed equally on each side of the primary coil; in other words, the entire length of each half of the secondary winding is directly adjacent to the whole primary winding. The diagram shows that the inside secondary coil is in series with the outside secondary coil. Such an interconnection insures that the resistances of the two secondary halves are equal and also that the reactances are equal; thus perfect regulation of the two halves is obtained and the voltage drop in either secondary circuit will not exceed the listed regulation drop under ordinary unbalanced load conditions.—*Gen. Elec. Rev.*, January, 1917.

Ultra-Violet Rays and the Eyes.—An article giving a summary of recent investigations on the effect of ultra-violet light on the eye and an editorial on the same subject. The higher the temperature of the source of light the greater the proportion of ultra-violet rays, but ordinary glass absorbs ultra-violet rays to a marked extent and the percentage of ultra-violet radiation from incandescent lamps is minute and smaller than that present in strong sunlight. There is no good reason to use special glass in the construction of electric incandescent lamps to provide against this supposed evil. "What is far more likely to produce harmful effect on eyesight is the use of sources of illumination of high intrinsic brilliancy, such as the ordinary tungsten lamp or half-watt lamp, unshaded, so that the eye receives light direct from the filament. It is regrettable to see the way in which clear glass lamps are still constantly used without proper shades. If those who should know better persist in this crude method of illumination more harm will be done to the eyesight than can possibly result through the presence of ultra-violet rays in the spectrum." On the other hand, in special work with arcs, with the quartz-tube mercury lamps, and in the case of auto-welding where the operator is necessarily at close quarters with the source, the use of special screens designed to protect against excess both of visible and of ultra-violet light is a natural and necessary precaution.—London *Electrician*, Dec. 1, 1916.

Variation of the Wave-Length Sensibility of Photoelectric Cells with Time.—HERBERT E. IVES.—A brief account of an investigation carried out in the physical laboratory of the United Gas Improvement Company of Philadelphia. In order to use the photoelectric cell in photometry it is essential that the cell have two qualities. First, the relationship between illumination and current should be rectilinear; second, the wave-length sensibility curve must be of permanent character, and for reasons of practicability it should be the same from one cell to another, in order that any means for screening to copy the wave-length sensibility curve of the eye would not have to be worked out separately for each cell.

An investigation of the first point by the author established the fact that photoelectric cells as previously made for photometric purposes could not be relied on to give the rectilinear relationship. Further study developed the explanation for this, and led to the design of a type of cell in which the current is strictly proportional to illumination. A simultaneous study of the wave-length sensibility characteristics of a number of cells showed these to be widely variant. The present work is part of an investigation being carried on to develop, if possible, cells of uniform and permanent characteristics, the question of permanency being first under study. The particular cell studied has potassium for the active metal, which is deposited on the inner walls of a 3-in. diameter bulb, leaving only a small spot clear for the entrance of the light. The potassium was colored by a hydrogen glow discharge, and the bulb afterward filled with helium gas at a pressure to give the maximum photoelectric current under working conditions. Measurements of the wave-length sensibility curve have been made at intervals over a period of eight months, during part of which time the cell has stood unused, part of the time it has been used for routine spectrophotometric measurements, and twice it has been exposed for an extended period to a considerable illumination with voltage applied so that a photoelectric current passed continuously. The result of this test is to show a gradual change in the shape of the wave-length sensibility curve, corresponding to either an increase of red or a decrease of blue sensitiveness, probably the latter. The relative blue and red sensitiveness has changed in the period mentioned by roughly 40 per cent. Time, rather than the amount of exposure of the cell, appears to be the determining factor. A slow diffusion of the sensitizing hydride layer into the pure alkali metal layer beneath is a possible explanation. The experiments will be continued.—*Journ. Franklin Inst.*, December, 1916.

Incandescent Lamps.—A note on a recent British patent (11,332, 1915) of C. A. Bastian for a method of avoiding the necessity for prolonged exhaustion of metallic filament lamp bulbs or filling them with a specially prepared inert gas consisting in absorbing the residual oxygen in a roughly exhausted bulb chemically by deoxidizing agents within an extension of the sealed bulb, which is heated externally.—London *Elec. Eng'ing*, Dec. 14, 1916.

Lubrication.—G. B. VICKERS.—A long abstract of a paper read before the Diesel Engine Users' Association on piston and end lubrication of Diesel engines.—London *Electrician*, Dec. 15, 1916.

Installations, Systems and Appliances

Electric Steel Furnaces in Sheffield Supplied from Central Stations.—A note stating that there are at present twenty electric furnaces connected to the electricity supply network of Sheffield, England, and sixteen are waiting to be connected, the total capacity being equivalent to an output of 100,000 tons of steel per year. "This particular application is now becoming so developed that the Sheffield Corporation has decided to promote a bill for powers to erect a new generating sta-

tion just outside the borough boundary at a cost of $7,500,000, with a view to giving a suitable supply. It is also interesting to note that the corporation has formed a development committee, charged particularly with the duty of keeping in touch with consumers and seeing in what way developments in electricity supply are desirable."—London *Electrician*, Dec. 22, 1916.

Field-Connection for Self-Starting Converters.—When a rotary converter is started from the alternating-current side, a strong alternating flux is set up, part of which links with the field coils and, since these have a large number of turns, induces a high voltage in them, which is liable to cause an insulation failure. One way of protecting the insulation is to mount a "field break-up" switch on the converter frame. When starting the converter this switch is opened, thus disconnecting the field coils from each other and preventing the voltages generated in the separate coils from adding in series. The connections for this scheme are shown in Fig. 3. Another scheme of connections for starting is shown in Fig. 4. The field switch is a plain

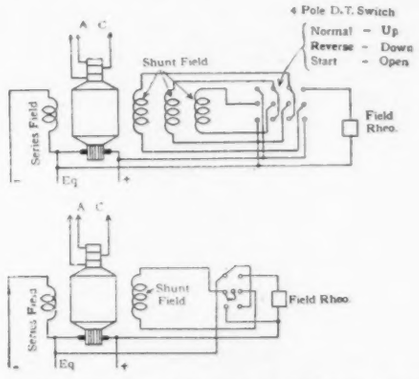


FIG. 3—FIELD CONNECTIONS THAT PREVENT DANGEROUS VOLTAGE INCREASES DURING STARTING

double-pole, reversing field, discharge switch. The switch is closed in the normal position for starting. There are two voltages acting on the field coils—one due to the transformer action of the armature flux, as in the previous case; the other, the armature emf. which is applied to the field coil terminals through the direct-current brushes. The latter voltage varies from line frequency at stand-still to zero frequency at synchronous speed, and its maximum value is the converter ratio times the alternating voltage applied. Since the resistance of the armature is small compared to its reactance, the reactance voltage will be of nearly the same magnitude as the applied voltage. The reactance voltage is generated by the same flux that induces voltage in the field coils, so that ratio of the induced field voltage to the armature voltage (which is nearly the same as the reactance voltage) will be approximately the ratio of shunt field turns to armature turns Consequently the induced field voltage is much greater than the armature voltage, so that no matter what phase relation these two voltages have, even if they are opposed, the field voltage will send current through the circuit composed of shunt field, field rheostat, direct-current brushes and armature. This current will neutralize part of the flux through the field coils and reduce the voltage induced in them. The action is similar to that of a series transformer—the armature corresponds to the primary, the shunt field to the secondary. Since the armature current is practically independent of the shunt-field current, the mutual flux will decrease as the field current increases, thus decreasing the voltage generated in the field. This scheme eliminates the complicated break-up switch and extra field wiring on the converter and affords satisfactory protection from high field voltage.—*Electric Journal*, January, 1917.

Wires, Wiring and Conduits

Copper Resistance at Temperatures Below Zero.—E. C. PARHAM.—Given the resistance R_o of a copper winding at a temperature of zero deg. C., the resistance R_t of that winding at a temperature of t deg. C. can be derived from the formula $R_t = R_o\ (1 + 0.0042\ X\ t)$. This holds good for all values of t met with in ordinary electrical practice (that is, the formula fails for very wide and unlimited temperature ranges); therefore the resistance R_s corresponding to a temperature s would be $R_s = R_o\ (1 + 0.0042\ X\ s)$. Usually the measured resistance R_t at a certain temperature, t, is known, and the resistance R_s at another temperature, s, is desired. From a combination of the above two formulas it follows that $R_s\ (1 + 0.0042\ t) = R_t\ (1 + 0.0042\ s)$. This formula does not involve R_o; consequently, the resistance R_s at any temperature, s, can be derived from the measured resistance R_t corresponding to any other temperature, t. It is assumed in the formula that the resistance is 100 per cent at zero deg. C., therefore, the resistances corresponding to negative temperatures will be less than 100 per cent. It follows, then, that where negative temperatures are involved, due reversal of algebraic sign must be observed in using the formula, otherwise misleading results will be obtained. To illustrate: In a locality where the temperature frequently dropped to —40 deg. C. a field coil was measured at —20 deg. C. and it was desired to know what would be the resistance at +20 deg. C. because that was the average room temperature in the season during which the machine was operating. The resistance R_t as measured at —20 deg. C. was 91.6 ohms. The quantities to be incorporated in the formula were $t = -20$, $R_t = 91.6$, and $s = +20$. In applying the formula we get $R_s\ (1 - 0.0042\ X\ 20) = 91.6\ (1 + 0.0042\ X\ 20)$ or $R_s = 108.4$ ohms.—*Gen. Elec. Rev.*, January, 1917.

Electrochemistry and Batteries

Current Efficiency in Copper Refining.—LAWRENCE ADDICKS.—The different items which lower current efficiency in the multiple system of electrolytic copper refining are discussed as follows: current leakage (to the ground, through the electrolyte, between electrodes); secondary reactions (deposition of impurities, gassing, valence); cathode shrinkage (sulphatizing, ferric salts, nodules, etc.). In practice it is possible with care and dismissal of questions of labor costs to obtain a working efficiency on a large scale of 99 per cent. Commercially it is found, however, that 92 per cent is about as high a figure as it is advisable to insist upon, and at some plants 90 per cent or even 88 per cent is considered satisfactory. Current density has a direct bearing on the problem in that a high density greatly increases the difficulty in preventing short-circuits between the electrodes.—*Met. & Chem. Eng'ing*, Jan. 1, 1917.

Units, Measurements and Instruments

Iron-Cored High-Frequency Current Transformers.—N. W. MCLACHLAN.—Campbell and Dye have demonstrated the use of current transformers with cores of stalloy stampings (silicon iron) for measuring very high-frequency alternating currents. During the progress of the work undertaken by the author on the magnetization of iron at very high frequencies, it became necessary to consider the theory of this method of measurement for such frequencies as occur in wireless telegraphy and the results of this investigation are given in the present paper which is of a highly theoretical nature.—London *Electrician*, Dec. 22, 1916.

SAMUEL KAHN

Samuel Kahn, who has just been elected vice-president of the new Pacific Coast Section of the National Electric Light Association, is the vice-president and general manager of the Western States Gas & Electric Company of Stockton, Cal. He is a native of San Antonio, Tex., and, after preliminary work at the University of Texas, was graduated from the School of Electrical Engineering of Purdue University in 1903. During the next six years Mr. Kahn served as engineer to the San Antonio Gas & Electric Company and the San Antonio Traction Company, and in 1909 he was appointed general manager of the Union Light & Power Company of Fargo, N. D. In May, 1911, he became general manager of the Appalachian Power Company, then a Byllesby property, with headquarters at Bluefield, W. Va., and ten months later he became assistant to the vice-president of H. M. Byllesby & Company, with headquarters at Chicago and Tacoma, Wash. Mr. Kahn has been vice-president and general manager of the Western States Gas & Electric Company since May, 1913.

William Sangster has been appointed superintendent of the Uncas Power Company's hydroelectric plant at Scotland Station, Conn.

A. W. K. Billings has returned from Barcelona, Spain, where he has been for the past five years as manager of construction, managing director and vice-president of the Ebro Irrigation & Power Company, Ltd., and allied interests, in responsible charge of extensive hydroelectric construction and other work. Over 110,000 hp. has already been developed, one interesting feature being the construction of the largest dam in Europe under very unusual conditions. Prior to his work in Spain and elsewhere for the Pearson interests Mr. Billings spent two years in Pittsburgh and ten years in Cuba, principally on electric railway and power plant construction, and two years in New York as engineering manager of J. G. White & Company, Inc. He has opened an office as consulting engineer at 115 Broadway and will devote considerable attention to engineering work in Europe and in Latin America.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

C. A. Felker, who for fifteen years has been a traveling representative for the Central Electric Company of Chicago, has been made manager of country sales for that company.

C. O. Randall, for the past seventeen years superintendent of the Colonial Power Company of Cavendish, Vt., has been appointed electrical superintendent of the Rutland (Vt.) Railway, Light & Power Company. Charles D. Spencer will succeed Mr. Randall as division superintendent and system operator of the Colonial company.

Pearl F. Hodgkins has been appointed local manager of the Blackstone Valley Gas & Electric Company, Pawtucket, R. I., succeeding A. F. Townsend, who has been transferred by the Stone & Webster Management Association to Beaumont, Tex. Joseph Pratt has been appointed superintendent of the distribution department and William Cheney has been placed at the head of the meter department of the Blackstone Valley Co.

H. H. Magdsick, who with R. F. Carbutt has just been awarded a medal by Mayor Mitchel's Committee of Two Hundred for his work in designing the flood-lighting of the Statue of Liberty in New York Harbor, is a member of the illuminating engineering department of the National Lamp Works of the General Electric Company, Cleveland, Ohio. Mr. Magdsick is a graduate of the University of Wisconsin, and has been with the lamp works for a number of years. Among his other important pieces of flood-lighting work was the illumination of the Woolworth Building, New York. With Mr. Carbutt, Mr. Magdsick was joint author of the article on the engineering features of the Liberty installation, published in the ELECTRICAL WORLD of Dec. 23.

H. H. MAGDSICK

I. E. MOULTROP

Irving E. Moultrop, assistant superintendent of the construction bureau, Edison Electric Illuminating Company of Boston, Mass., completed twenty-five years of service with the company on Jan. 1, and in recognition of the occasion was presented with a handsome traveling bag by his associates. Mr. Moultrop was born in Marlboro, Mass., in 1865. After serving a number of years with the Whittier Machine Company at Roxbury, Mass., he joined the staff of the Boston Edison Company in 1892 and has since contributed largely to the layout of steam apparatus for the company's generating plants. Mr. Moultrop's work on the prime movers committee of the National Electric Light Association is well known among central-station engineers. He has also served as manager of the American Society of Mechanical Engineers (from 1908 to 1911) and as vice-president of that organization (from 1912 to 1914). Mr. Moultrop is a member of the A. I. E. E., the Engineers Club of Boston, and the Boston Society of Civil Engineers.

T. D. Witherspoon has resigned his position as chief draftsman of the Union Electric Light & Power Company of St. Louis, Mo., to become engineer in charge of construction for The Milwaukee (Wis.) Electric Railway & Light Company. Mr. Witherspoon graduated from Rose Polytechnic Institute in 1900 with a B.S. degree, and at that time entered the employ of the National Malleable Castings Company of Chicago. He has had wide engineering experience with the Pennsylvania Railroad, Youngstown (Ohio) Engineering Company, and the Toledo Furnace Company.

Obituary

Alfred B. Jenkins, president of the valve manufacturing firm of Jenkins Brothers of New York City, died at his home in West Orange, N. J., Dec. 29.

Horace D. Bean, manager of the Roller-Smith Company's factory of Bethlehem, Pa., died suddenly while on a visit to his old home at Penacook, N. H. Mr. Bean was forty-five years old.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Improved Mercury Vapor Lamps

The Cooper-Hewitt Lamp Company of Hoboken, N. J., has made several improvements and added new types to its line of lamps. A complete Cooper-Hewitt lamp outfit consists of the tube, the auxiliary and the reflector-holder. The tube is of clear glass with electrodes at each end and contains a small quantity of metallic mercury. The current passing between the electrodes, vaporizes a portion of the mercury, and causes the tube to glow with a soft, bright radiance. The auxiliary consists of the operating mechanism, together with the supporting framework; the

AUTOMATIC TILTING MERCURY VAPOR LAMP

auxiliary being inclosed in an enamel sheet metal cover. The shifter, which is mounted in the auxiliary, is a small glass vessel with two electrodes and contains a small quantity of mercury. The shifter serves for lighting the tube, and operates automatically. The reflector-holder supports the tube in two clamps and is attached to the auxiliary.

The type P automatic lighting-tilting type lamp with FA auxiliary has an average current rating of 3.5 amp., 385 watts, a mean hemispherical candle power with reflector of 800, a commercial efficiency-watts per M. H. candle of 0.48, with length of light-giving tube 50 in., and diameter of tube 1 in. The improvements in the auxiliary are larger coils and a different arrangement of the shifter. The outfit takes less headroom and allows the tube to be hung closer to the ceiling. It is equipped with two insulated hangers, but when only one suspension point is available in the ceiling, as in the case of an outlet box, a horizontal suspension bar with a hook on each end and a cross in the middle may be secured.

The new type L lamp has an average current rating of 2 amp., total watts 220, mean hemispherical candle power of each lamp, with reflector, 400; commercial efficiency in watts per M. H. candle, 0.55; length of light-giving tube, 35 in., and diameter, 0.75 in.

This lamp has been developed to meet the demand for a unit smaller than the type P (385 watts), where it is essential to have a multiple lamp with high efficiency. The type L lamp is automatic in starting and does not have to be tilted for lighting. It requires little head-room and can be hung very close to the ceiling. The lamp outfit has two insulated hangers, but when only one suspension point is available at the ceiling, it can be suspended in the same way as described in the type P unit.

Vacuum Cleaner with Automatically Controlled Suction Space

Several features are claimed for the vacuum cleaner shown here that has been developed by the Apex Electrical Manufacturing Company, 1111 Power Avenue, Cleveland, Ohio. This cleaner is mounted on a three-wheel carriage, leaving the body free to operate its self-and-automatic adjustment, which permits the cleaner to be operated on the bare floor and on the thickest rug or carpet, and conveys the maximum cleaning power through automatic control of the required suction space along the nozzle front, regardless of the surface it may be cleaning.

As shown in the circle inset of the illustration, the upper wall of the nozzle is made with rounded, diagonal-set, protruding ribs that distribute the suction evenly across the entire nozzle—and that riffle the surface of floor covering to enable the suction to easily draw up all deeply embedded particles of heavier dirt. The nozzle, too, is designed to confine the air into the nap of the carpet and not on the surface.

VACUUM CLEANER MOUNTED ON A THREE-WHEEL CARRIAGE

An improved, revolving brush, traction operated, is mounted in a sunken housing or shroud, so that the brush itself does not interfere with, or in any way impede the suction, the latter merely passing over the extreme ends of the brush so as to gather off the lint, hair, thread, etc., that has been loosened and picked up.

Extension or Remote Tank Gage

The Universal Tank Gage Company of Tacoma, Wash., has developed an extension or remote tank gage that shows on a vertical scale the amount of liquid

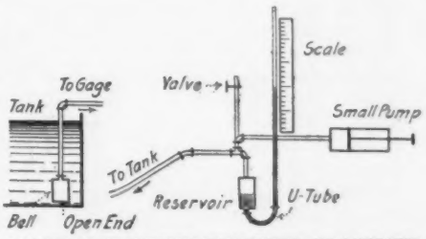


DIAGRAM SHOWING FEATURES OF REMOTE TANK GAGE

in a tank. The gage consists of a U tube containing a colored liquid, arranged as shown in the accompanying illustration. The long arm of the tube is open to the air; the other is cut quite short and connected to a small reservoir of a size sufficient to hold the contents of the other arm. The top of the reservoir is connected by means of ⅛-in. copper tubing to the tank, this tubing terminating in a small bell which is placed open and downward. At the gage end of the connecting tube is a small hand air pump and valve, as shown in the illustration.

After the instrument is set up and connected to the tank, air is pumped into the tubing until it bubbles freely from the bell in tank. The air then in the tubing is under atmospheric pressure plus the head due to the height of the liquid in the tank, which is exactly counterbalanced by the column in U tube. As the contents of the tank is drawn off the air escapes from the bell and the column in the gage glass falls. When the tank is filled the process is reversed, but if air is compressed too much and the liquid is forced into the copper tubing a few strokes of the hand pump will correct it. The change in temperature is automatically cared for, a rising temperature merely forcing a

little air out of the bell in the tank. A falling temperature will cause the column of liquid to read slightly lower than it should and this can be corrected by using the pump. There is no capillary action to be adjusted for, it is claimed, since there is no liquid in the small tube.

This gage is guaranteed to read within 1/16-in., and its operation is independent of the location of the tank. It is made in various forms for use on fuel oil, water, gasoline or any tank containing liquid and is used in garages, on automobiles, on gas tanks, in ships to indicate level of bilge water, and in power stations.

Dental Roentgen Ray Machine

The Wappler Electric Company of New York has developed an interrupterless dental roentgen machine which is constructed upon the same principles as its largest roentgen machines. The accompanying illustration shows the complete unit, in which the alternating current is rectified with a Wappler rectifying disk and delivered as a unidirectional current for the tube, insuring a long life for the tube and perfect, clear pictures with good contrast. Five stages of voltage are provided. With the highest the tube will back up 6 in. and give a good picture of the lateral and frontal sinus in four to five seconds. The power in the tube would be about 40 milliamperes. The pictures, it is said, will always show good contrasts, and the results obtained can be compared in every way with the quality of work obtained from the more powerful and expensive machines.

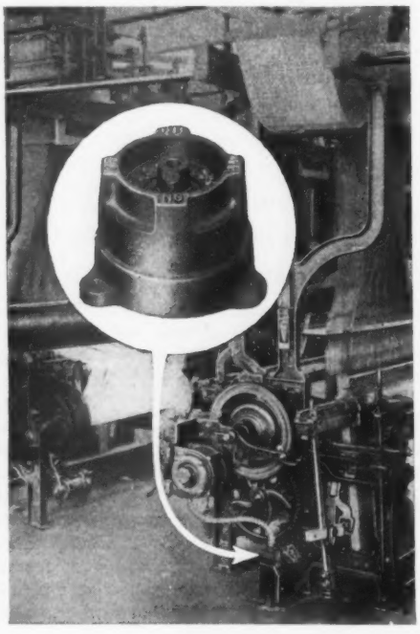
A milliampere meter is mounted on the machine, also a sparkgap to measure the back-up and penetrating power of the tube. Automatic tube reels con-

ROENTGEN RAY MACHINE FOR DENTAL WORK

nect the tube to the high-tension terminals. The safety switchboard permits only the operating levers to protrude, eliminating the possibility of shock. All types of tubes may be used with the dental interrupterless machine.

Indicating Switch for Small A.C. Motors

The triple pole indicating switch shown in the accompanying illustration has been designed for use where machines are individually driven by alternating-current motors of 2 hp. and smaller. The "shell" or cover is a one-piece iron casting and is dust tight, which makes it suitable for mill installations. The switch mechanism is mounted on a porcelain block, which is entirely inclosed within the cover. As will be noted from the illustration, the indicating switch handle is countersunk below the top rim of cover, upon which are cast the words "off" and "on." By this construction the handle is perfectly accessible, the position of switch may



TRIPLE POLE INDICATING SWITCH FOR MILL INSTALLATIONS

be readily seen, and at the same time it is protected from damage and accidental operation. Three supporting ears are provided at the bottom of the cover and so spaced as to permit of ready installation on PG and ZG condulets. This switch carries an approved rating of 20 amp., 250 volts, and may be used for controlling three-phase alternating-current motors up to and including 2 hp.

Accessible Photometer Sight Box

A photometer sight box which has been developed by the Leeds & Northrup Company, Stenton Avenue, Philadelphia, Pa., is shown in the accompanying illustrations. When the top of the instrument is taken off by removing a thumbscrew all working parts are exposed to view. The cube, in its mounting, may be easily removed, the mounting sliding in grooves provided for this purpose. Totally reflecting prisms are used on the sides of the box in place of mirrors. An advantage of prisms, it is claimed, is found in the fact that silvered mirrors are selective and thus introduce errors in the results obtained when sources of different color values are being compared. The Lummer Brodhun cube is the most important part of the instrument, and great care, it is pointed out, is taken in its con-

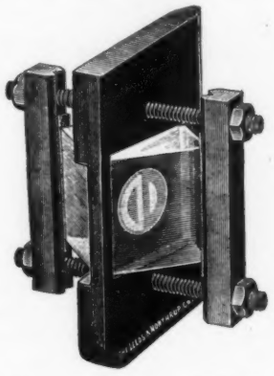


FIG. 1—SIGHT BOX CUBE IN ITS MOUNTING

struction. The two hypotenuse faces of the prisms upon which the designs are etched must be plane, since it is absolutely necessary that when mounted they should be in optical contact. Each instrument is provided with absorption glasses for use with the contrast cube. When the absorption glasses are not in use they are turned out of the way by means of knurled heads on the outside of the instrument. Arrows on the knurled heads pointing toward the arrows on the box indicate when the absorption glasses are in

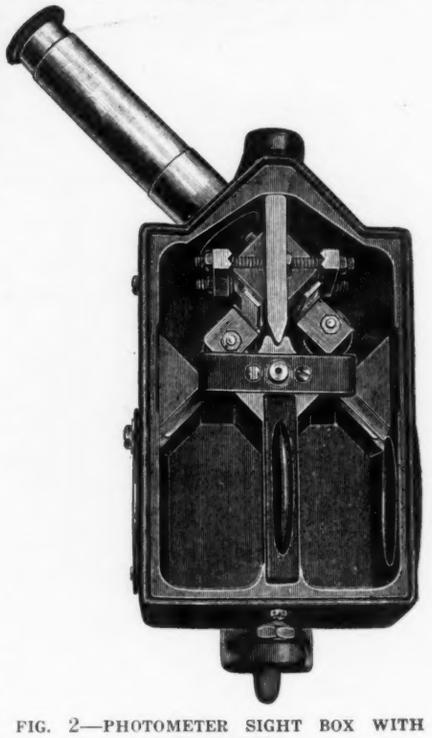
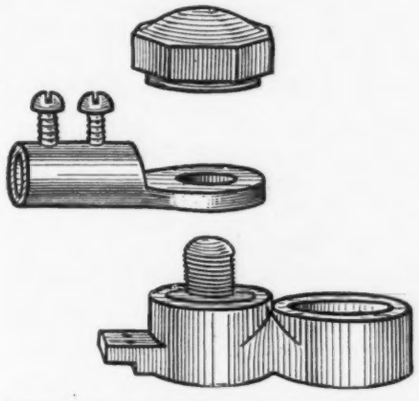


FIG. 2—PHOTOMETER SIGHT BOX WITH TOP REMOVED

place. It is never necessary to remove these glasses from the instrument, thus eliminating a very common cause of breakage. The box weighs, without mounting bracket, only 1.5 lb. The overall dimensions are 3.5 in. by 5.75 in. by 2.5 in., excluding telescope.

Adaptable Terminal Connector

An adaptable terminal connector which consists of a lead alloy connector with a threaded stud anchored in the body, a wire terminal, and a nut on the



TERMINAL CONNECTOR THAT PREVENTS BREAKING OF BATTERY PLATE

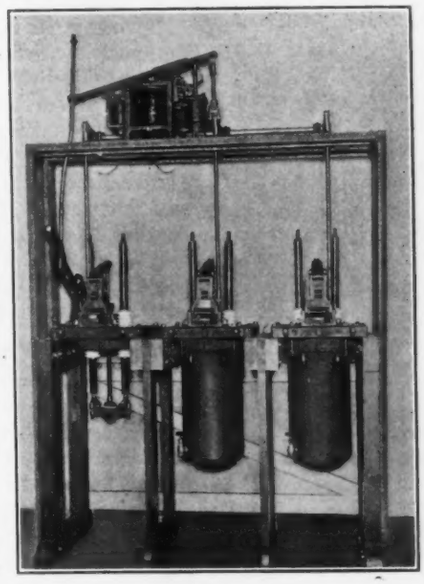
threaded stud to clamp the terminal to the connector has been developed by Paul M. Marko, 1191 Bedford Avenue, Brooklyn, N. Y. The wire terminal into which the bare cable is inserted can be fastened by set screws or by solder. The anchored stud is spaced at a distance from the battery terminal post, which, it is claimed, prevents corrosion should creeping by acid take place along the terminal post. The terminal can be clamped on the seat of the connector at any angle. The maker calls attention to the fact that the feature of this connector is that it prevents the breaking of the battery plate when the nut is tightened.

Oil Circuit Breakers for Cell Mounting

The two forms of oil circuit breakers, one of which is shown in the accompanying illustration, designated as types O-1 and O-2, have recently been placed on the market by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. These breakers are for voltages up to 25,000 and are furnished in current capacities of 600 to 4000 amp. They are supplied in two frames, the type O-1 with current capacities up to and including 1600 amp., for plants up to 80,000 kva., three-phase rupturing capacity (a root mean square value of 500,000 kva. ruptured at contacts) and the type O-2, a larger frame, with current capacities of 2000, 3000 and 4000 amp. for plants up to 100,000 kva., three-phase rupturing capacity (a root mean square value of 625,000 kva. ruptured at contacts). The high capacity ratings of these breakers, it is claimed, are due to the form of tank, the use of steel supporting flanges, and large volume and head of oil. The tanks are round in form and seamless. They are die pressed from heavy sheet steel, representing the strongest tank construction possible, it is claimed.

Both types of breakers are furnished in single-pole unit form for cell mounting only, each pole unit to be mounted in a separate brick or concrete compartment in the standard arrangement. The operating mechanism, which is mounted on top of the cell structure on a channel and plate base supported from the cell structure, is solenoid operated and consists of a common operating shaft with levers and rods operating the several poles as a unit. Each pole unit is complete with a heavy steel frame supporting the contacts and tanks, and is provided with an independently adjusted toggle lever arrangement for operating the moving contacts. Adjustments for contact pressure and travel can be made in each pole unit independently. An accelerating spring and dashpot is operated as part of the common control mechanism to assist in forcing the circuit breaker to the open position and in taking up the shock of the moving parts.

The live metal parts of each pole are immersed in a separate single piece



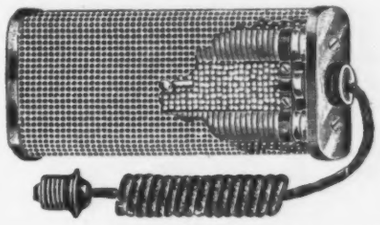
OIL CIRCUIT BREAKER MADE IN CURRENT CAPACITIES OF FROM 600 TO 1600 AMP.

round steel tank which can be removed readily without interfering with the other parts of the breaker. Drain and filler fittings and oil gages are furnished so that the tanks can be emptied before lowering, or filled when in position. As a protection from arcing to ground, a removable Micarta insulating lining is used in each tank. The tanks are deep to allow ample head of oil and space above the oil for a compression chamber to reduce internal gas pressure.

All types O-1 and O-2 breakers are furnished as either automatic or nonautomatic. Automatic operation of nonautomatic breakers may be obtained by the application of suitable relays for actuating the shunt tripping coils. Such auxiliaries as under-voltage trip devices of the self-resetting type, shunt or under-voltage trips, and mechanical interlocks can also be obtained when necessary.

Electric Heater for Automobile Engines

An electric heater for automobile engines and radiators which, it is claimed, will keep water in radiators warm in the coldest weather is being offered the trade by the Metal Specialties Manufacturing Company of Chicago, Ill. The thin oval shape of the heater permits



THIN OVAL SHAPED ELECTRIC HEATER FOR AUTOMOBILE ENGINES

it being placed wherever heat is desired. The heater is 7 in. long, 3.5 in. wide and 1.5 in. thick, and consumes 220 watts. This electric heater is furnished with 10 ft. of cord and attachment plug.

Three Draft Gages Combined in One

The 3 in 1 air gage shown in the accompanying illustration has been designed to meet the demand for concentrated control of the draft conditions of any forced-draft furnace, but particularly for boiler service. The ranges

THREE DRAFT GAGES IN ONE FOR BOILER SERVICE

are 0 to 2 for the damper or last pass draft, — 1 to 0 to + 1 for the combustion chamber, and 0 to 6 or 0 to 8 for the ash pit. The case is of cast-iron, all black enameled. This gage is of the dead-beat type.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

UNION ELECTRIC VALUATION

Commission Experts Estimate the Cost of Reproduction New at $22,757,409

Additional information regarding the valuations of the Union Electric Light and Power Company of St. Louis, Mo., has been received.

The appraisal of the Missouri Public Service Commission placed an estimate of the cost of reproduction new of the physical property of the company at $22,757,409. This did not include an allowance for preliminary expense, promotion, cash working capital or going value, because the engineering department of the commission reported on physical values only. The company placed a value of $25,384,888 on its physical property and a total value of $31,206,950.

A comparison of the company's valuation with that of the commission follows:

	Commission Appraisal	Union Electric Company Appraisal
Land	$1,522,743	$2,958,560
Buildings	3,134,124	3,200,771
Equipment	6,303,551	6,514,363
Transmission and distribution	7,759,564	7,908,981
Teams, autos, tools and office equipment, electric signs	285,772	368,825
Rights—licenses	225,977	248,751
Stores and supplies	401,550	421,697
Overhead charges	3,124,128	3,762,940
Total	$22,757,409	$25,384,888
Cash		788,960
Promotion, brokerage, etc.		533,102
Going value		4,500,000
		$31,206,950

PACIFIC GAS & ELECTRIC GETS ORO PROPERTIES

California Commission Authorizes Sale Urging Company to Be Liberal in Making Extension Into Territory Not Developed by Oro Concern

The California Railroad Commission has issued an order authorizing the Oro Electric Corporation and the Oro Water, Light & Power Company to sell to the Pacific Gas & Electric Company their entire public utility properties, with certain exceptions, and the Pacific Gas & Electric Company to issue at not less than 90 per cent of face value its general and refunding bonds to realize the sum of $1,491,151.35 to reimburse the treasury of the Pacific company for money expended in the purchase of the bonds of the Oro Electric Corporation.

The Oro Electric Corporation has an authorized issue of $10,000,000 capital stock, and $10,000,000 of 6 per cent first mortgage bonds. Of the stock, $1,950,000 is owned by the Oroville Water, Light & Power Company and $8,050,000 is in the hands of the public. Of the bonds, $1,830,000 were reported in the application of the Pacific company as in the hands of the public and $180,000 in the treasury of the Oro Electric Corporation. The other Oro companies also have issues of stocks and bonds which are mentioned in detail in the commission's decision. The books of the Oro Electric Corporation and subsidiary corporations show that the cost of their public utilities properties was $3,488,249.

Public Service Commission News

Michigan Commission

Vol. 5, No. 2, of the orders and opinions of the Railroad Commission covering the period from July 1 to Sept. 30, 1916, has been issued.

California Commission

Volume I of the report of the Railroad Commission of California from July 1, 1915, to June 30, 1916, has just been printed. The present volume is a narrative of the work done by the commission during the fiscal year ended June 30 last. Volume II, which is not yet ready for distribution, is a digest of the finances of California public utilities.

Wisconsin Commission

In fixing the rates of the Tomah Electric & Telephone Company, which does not own a generating station but purchases all the energy distributed, the Railroad Commission prescribed rates that would yield over 9 per cent on a rate-making value of $30,000. This return, the commission says, "may seem a little high at the first glance, but, bearing in mind the size of the property and that this property is operated very economically, and further that the general officers of the company receive only a nominal sum, $150 a year, for their services to the electric utility, it seems to us that the total return is not unreasonable."

Massachusetts Commission

At a recent hearing before the Massachusetts Gas & Electric Light Commission upon a petition of the Edison Electric Illuminating Company of Boston for a stock increase, General Morris Schaff, senior member of the board, discussed public utility management with special reference to surplus. When the board originated, surpluses were encouraged for the security of the property and the natural obligations of the consumer with respect to surplus accumulation were laid down. "In doing this," the commission stated in part, "we created, unfortunately, one of the greatest evils, not unknowingly, that I think has befallen our public service corporations. These surpluses we created immediately became the target, became the prey of the people who created our public utility holding companies. They bought those stocks and then turned in and capitalized all those surpluses. And we are to-day suffering from the evil of our own creation, and we have up to this time been hardly able to hold our own against it. But I think the tide is turning and public opinion is going to compel these people to loosen their grasp on these public service corporations.

"Now, so much for that reference to surplus. There is a limit where a surplus would be wrong. That is for the management and the directors to fully decide. The earning power of that surplus, however, must be divided between the people who created it and the people who have the honest title to it. I do want to impress upon every man connected with these public service corporations that our first desire is to see that the money that has gone in there shall be absolutely protected, and shall be as sure as it can be made of a dividend."

Will Recommend Addition of Public Necessity and Convenience Clause to Oregon Law.—Public Service Commissioner Corey, Salem, Ore., has announced that he will recommend to the Legislature that the public utilities law be amended to contain the usual public necessity and convenience clause. Such an amendment was introduced at the 1915 session of the Legislature, but was defeated after a close contest, in the house.

A New Overhead Line Trouble.—Evidence that there is no limit to the variety of overhead line troubles is submitted by S. W. Borden, general manager of the coast division of the Lakewood and Coast Electric Company of Summit, N. J., who writes that a few days ago the company's emergency men were called out to disentangle an aeroplane from their overhead wires and to rescue the driver by means of an extension ladder.

Large Public Utility Development Ahead for California.—California public utility development aggregating $25,000,000 has been presented to the Railroad Commission for investigation and approval during the last few months. Of this amount, $16,700,000 is involved in application for issuance of public utility securities for extensions, additions, betterments and mergers in northern California and at least $8,500,000 for southern California. Some of these applications have been granted by the commission, while the remainder are under consideration and affirming orders are expected at any time. Of the utilities included in the list, hydroelectric corporations are contemplating the largest development expenditures, water companies come next and last intrastate railroads. The applications disclose that all the utilities are enlarging their plants, extending into new territory and improving the systems already in operation.

May Install Telautograph System in Senate.—Experiments are being made in Washington to ascertain if it would be possible to install in the Senate a telautograph system, or something similar to it, electrically operated, to inform Senators while in their offices what is going on in the Senate chamber. Under the present system of informing Senators what is going on in the Senate chamber, a series of call bells, ringing from one to five, announces to them that a roll-call is then being demanded, or that no quorum is present, or other similar information. Under the proposed system, a clerk at the reading desk of the Senate, or beneath the chair of the presiding officer, would record upon an electrical device similar to the so-called telautograph what is actually happening on the floor of the Senate, such as "Senator So-and-so" is wanted on the floor, "The army appropriation bill is now up for debate," etc. The old-fashioned call-bell system, which means the loud ringing of a gong, with only five indications of what is transpiring in the Senate chamber, is felt by some of the younger Senators to be out of date and not sufficiently indicative.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

New Jersey Capital Considering Municipal Ownership.—Mayor Donnelly of Trenton, N. J., has engaged F. W. Ballard to make investigations of local water-power properties and of the feasibility of utilization for the installation of hydroelectric plants for municipal operation.

Big Increase in Zinc Production.—The new year estimate of the production of zinc in 1917, just issued by the United States Geological Survey, shows the recoverable zinc content of ore mined in the United States in 1916 as 708,000 tons, a gain of more than 120,000 tons, or 20 per cent, as compared with 1915. The Joplin region made the largest gain.

May Hear Inaugural Address by 'Phone.—Gatherings in all parts of the country may be able to listen to President Wilson's inaugural address on the morning of March 5 by long-distance telephone. The Washington inauguration committee has taken up with telephone companies the feasibility of such an arrangement, and it was pronounced quite possible.

Increase in Number of Commonwealth Edison Company's Employees.—In September, 1916, the total number of employees of the company was 5336, or a 25 per cent increase for the year. Over the same period of time the amount of the company's payroll increased 31.3 per cent. Of all the company's employees, 65 per cent have been with the company less than five years, 8⅓ per cent, ten years but less than fifteen; 3 per cent, fifteen but less than twenty years; 2 per cent, twenty but less than twenty-five years; 0.8 per cent, twenty-five but less than thirty years, and only 0.08 per cent, or four persons, had a record of thirty years' continuous service or longer.

Bill to Prohibit Spreading of Light and Power Utility Control in Texas.—Among the several bills that are directed against corporations which have been introduced in the Legislature of Texas at the present session is one by Senator I. F. Clarke of Schulenberg, which provides that no light and power company, firms or business interests that already own an electric light and power plant shall be permitted to purchase, lease or acquire the business or another electric light and power concern. Another bill affecting electrical interests is that introduced by J. W. Parks, which provides for creating the office of chief electrical inspector to be appointed by the Governor and requiring the licensing of firms and individuals in the electrical contracting business.

Franchises Submitted to Dallas Taxpayers for Vote.—The Dallas Commission has submitted to vote of the taxpayers the proposition of granting franchises for organizing a proposed new electric light and street railways company in Dallas. The election will be held on April 3. The franchises have already been granted by the City Commission, and the vote upon them will be in the nature of a referendum. Immediately upon granting the franchises the attorneys for J. F. Strickland, who will head the new light company, and C. W. Hobson, head of the new street railway company, filed bonds in the amount of $1,000,000 to guarantee to the city the carrying out of specified agreements to comply with the ordinances. In the recent postcard ballot the voters showed themselves to be overwhelmingly in favor of granting the proposed franchises.

Negotiating a Street Lighting Increase.—A proposal to increase street lighting rates is fundamentally an unwelcome task, but a recent letter of J. G. Meunt, general manager of the Colonial Power & Light Company, to the Village and Fire District of Manchester, Vt., handles such a problem in a frank and interesting way. The author pointed out that doubtless in their knowledge of conditions existing in other towns, the municipal authorities must have realized that the price the Colonial company is now charging for street lights is somewhat below the ordinary figure. In view of the former difficulties with the service the management of the company had refrained from raising this question prior to the completion of arrangements for a service of as good quality as any city or town could desire. The point was then made that in comparing the price for the Manchester street lighting with the prices charged for similar service in other towns one or two things must be true: that the prices charged in other town are exorbitant or else that the price charged in Manchester must be below the actual cost of the service.

"Owing to the fact that the Public Service Commission of Vermont has a careful supervision over such prices and because of the fact that there have been several cases dismissed before this board and settled by it," says the letter, "we believe that you will agree with us when we say that we feel that the true conclusion is not that prices charged in other towns are too high, but that the price charged in Manchester is too low; and we do not think that you will feel it fair that the company should continue to supply service at a very considerable loss." In quoting the following rates, which the company desires to have established in a new contract, the management stated that pending consideration and discussion of the matter, the present street lighting service in Manchester would be supplied after Jan. 1, 1917, at $1.60 per month per lamp. The proposed rates, now under consideration, are $18 per year per 32-cp. lamp burned all night and $20 per all-night 60-cp. lamp; $15 per 32-cp. and $18 per 60-cp. lamp burned until midnight.

Automobile Headlights.—W. F. Little, of the Electrical Testing Laboratories, presented before the New York section of the Illuminating Engineering Society on Jan. 10 a survey of the automobile headlight situation.

Safety Meeting for Pittsburgh Iron and Steel Electrical Engineers. — The February meeting of the Pittsburgh section of the Association of Iron & Steel Eectrical Engineers will be held on Feb. 17 at the Fort Pitt Hotel, under the auspices of the safety committee, H. A. Schultz, chairman.

Dallas Electric Club Officers.—The Dallas Electric Club and Jovian League at its weekly luncheon elected the following officers for the year 1917: Ben K. Howard, president; E. E. Roessler, secretary; E. G. Warner, assistant secretary, and R. W. Wakefield, E. M. Powell and L. A. Ott, vice-presidents.

Brooklyn Section N. E. L. A.—The annual meeting of the Brooklyn Company section was held on Jan. 16. T. I. Jones, general sales agent, Brooklyn Edison company, spoke on the growth of the company during the year. W. F. Wells, vice-president and general manager of the company, delivered an address.

New York Electric Production Meeting.—The electric production committee of the Empire State Gas and Electric Association held a meeting in the Onondaga Hotel, Syracuse, on Jan. 12. The general subject for discussion was "Fuel, Coal-Handling, Stokers and Furnaces—and Smoke Prevention." There was a question box at the morning session and the questions asked were discussed at the afternoon session.

Florida Engineers Organize.—The Florida Engineering Society was organized recently in Jacksonville with a charter membership list of eighty-four. The officers are: President, L. D. Smoot, Jacksonville; vice-presidents, W. P. Darwin, Jacksonville, and R. E. Chandler, Gainesville; secretary, J. R. Benton, Gainesville, and treasurer, H. D. Mendenhall, Lakeland. The first annual meeting of the society will be held at Tampa, Fla., on Feb. 2 and 3.

New York Electrical Society Hears Choralcelo.—The New York Electrical Society held its 352nd meeting at the Choralcelo Galleries, New York City, on January 15. E. R. Knowles lectured on "Dust, Its Universality, Its Conservation and Its Elimination." After Mr. Knowles' address Guy P. Norton spoke on the operative principles of the Choralcelo, the music of which is produced electrically. His talk was accompanied by many striking illustrations.

Meeting of Worcester Polytechnic Institute Branch.—The fourth regular meeting of the Worcester Polytechnic Institute branch of the American Institute of Electrical Engineers was held Jan. 5. This meeting was a joint meeting with the local Civil Engineering Society and the student branch of the American Society of Mechanical Engineers. H. T. Miller of Boston, New England agent, National Tube Company, presented a lecture entitled "From Ore to Finished National Pipe."

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Iowa Contractors to Meet. — The semi-annual meeting of the Electrical Contractors' Association of Iowa will be held at Cedar Rapids on Jan. 30 and 31.

Store Lighting Discussed at Chicago.—A. L. Powell, illuminating engineer, Edison Lamp Works, addressed the Chicago Section of the Illuminating Engineering Society on Jan. 9, his subject being "Store Lighting."

Wisconsin Association Meeting.—The annual meeting of the Wisconsin Electrical Association will be held at the Hotel Phister, Milwaukee, on March 15 and 16. W. E. Haseltine of Ripon, Wis., is president of the association.

Portland (Ore.) Sections, A. I. E. E. and N. E. L. A.—The sections were addressed at a recent luncheon in the Oregon Hotel by A. H. Babcock, consulting electrical engineer for the Southern Pacific Company, San Francisco, who talked on "The National Reserve Corps of Engineers." Paul Lebenbaum, electrical engineer, Southern Pacific Company, Portland division, acted as chairman.

Electrical Club of Toledo.—A dinner is being arranged by the club for the members of the Western Association of Electrical Inspectors, which will hold its convention at Toledo on Jan. 23, 24 and 25. Chairmen of the ten committees appointed to look after the matter are: H. R. Fowler, J. W. Strub, Albert A. Merickel, S. M. Strub, J. N. Riddell, H. C. Scannell, E. Berger, G. Sothern and F. L. Lucas.

Annual Meeting of Wisconsin Engineers.—The Engineering Society of Wisconsin, which will hold its annual meeting at Madison on Feb. 15 and 16, will include in its program the following papers which may be of interest to electrical men: "Valuation Methods," by F. J. Bachelder; "Public Service Regulation," by L. F. Boon; "Street Lighting," by F. A. Vaughn, and "Wisconsin Conservation Law," by H. V. Tennant, to be followed with discussion by W. D. Mead.

Commission Valuation Rough Guess, Says Former Commission Engineer.—James E. Allison, president of the James E. Allison Company, in an address before the St. Louis Jovian League luncheon meeting on Jan. 9, cited facts showing how it was impossible for a commission to place a fair valuation on public utility property that has been operated. Mr. Allison, who formerly served as engineer of the Missouri Public Utilities Commission, stated that owing to the impossibility of estimating the future earning power of a utility property, to attempt to estimate depreciation of mechanical values or the appreciation of organization values, was nothing more than a rough guess.

Louisville Jovians Reorganize with Local and National Members.—According to a proposal approved unanimously by the members of the Louisville Jovian League, that organization will continue its existence, though as an independent association of men in the electrical industry. It will receive a charter from the Jovian Order and its membership will include those who are members of both the local and the general organizations, as well as those who are members only of the local, to which the charter will be granted on account of the local members who have qualified, by remitting the increased dues, as members of the Order. However, according to action taken at the same meeting at which the amended constitution and by-laws were adopted, the men who are members of the Jovian Order will not pay, in addition, dues to the local organization, which are $2 annually. It is proposed that an arrangement will be worked out by which the league shall each year choose from its membership perhaps fifteen who will be named to represent it as ranking Jovians. Such a disposition of the matter will stand for a year. The annual meeting and election of officers of the Louisville Jovian League will be held at one of the local hotels on the evening of Jan. 30. It will be a banquet meeting, with enrollment of new members, after which the election of officers will be held.

New York Companies Section Hear New York Edison Figures. — Arthur Williams of the New York Edison Company on June 16 spoke before the New York Companies Section of the National Electric Light Association on "Reminiscences and Forecasts." Mr. Williams told of the growth of electric service in New York City since its beginning, illustrating his remarks with pictures. He also gave some figures to show the extent of electric service supplied by his company at the beginning of 1917. More than 200,000 separate customers, served through a considerably greater number of meters, have an aggregate connected load of, roughly, 15,000,000 in 50-watt equivalents, or 750,000 kw. Nearly 500,000 hp. in elevator and industrial motor load is recorded on the company's books, and there are many such motors of which the company has no record. Based on a 3 to 4 cent per kilowatt-hour rate, the annual income from electric vehicles in New York City for battery charging is $18,000,000. The company has 1000 telephones. The daily number of telephone messages to and from customers is 8000 calls. The daily incoming mail contains 7000 letters. More than 1,500,000 separate parcels are sent out yearly either by mail or by local delivery. Although the number of customers is increasing, the number of complaints is decreasing. But 8700 complaints were received last year. Following Mr. Williams, Mr. Robert A. Carter, vice-president of the Consolidated Gas Company, made a few remarks.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

SALES BILLED BY LARGE MANUFACTURERS IN 1916

General Electric, Western Electric and Westinghouse Sales Total More Than $305,000,000—Unfilled Orders Are in Excess of $105,000,000

In many respects the year that has just passed was remarkable, especially so as regards the sales billed for electrical goods. In 1916 the sales billed by the three largest distributers of electrical goods, the General Electric Company, the Western Electric Company and the Westinghouse Electric & Manufacturing Company, amounted to more than $305,000,000, while the value of unfilled orders on Dec. 31 was in excess of $105,000,000.

In comparison with 1915 this was a gain of $117,000,000, or 62.3 per cent in sales billed, and $62,000,000, or 144 per cent in unfilled orders. Previous to 1916 the largest year was 1913, when the sales billed amounted to $228,000,000. The sales billed last year, therefore, were $77,000,000, or 34 per cent greater than in the industry's largest previous year.

Compared with 1915 and with 1913 the sales billed by these companies for last year were as follows: General Electric Company—1916, $120,000,000; 1915, $85,500,000; 1913, $107,000,000. Western Electric Company—1916, $105,000,000; 1915, $63,800,000; 1913, $77,500,000. Westinghouse Electric & Manufacturing Company—1916, $80,000,000; 1915, $38,000,000; 1913, $43,700,000. These figures are for the regular line of products and do not include orders for war munitions. The 1915 and 1913 Westinghouse figures are for the fiscal year which ended March 31 of the following year in each case, while the 1916 figures are for the calendar year. Therefore, compared with the 1915 fiscal year that included the first quarter of 1916 the Westinghouse figures for the calendar year 1916 do not show as large an increase by many millions of dollars as if they had been compared with the figures for the calendar year 1915.

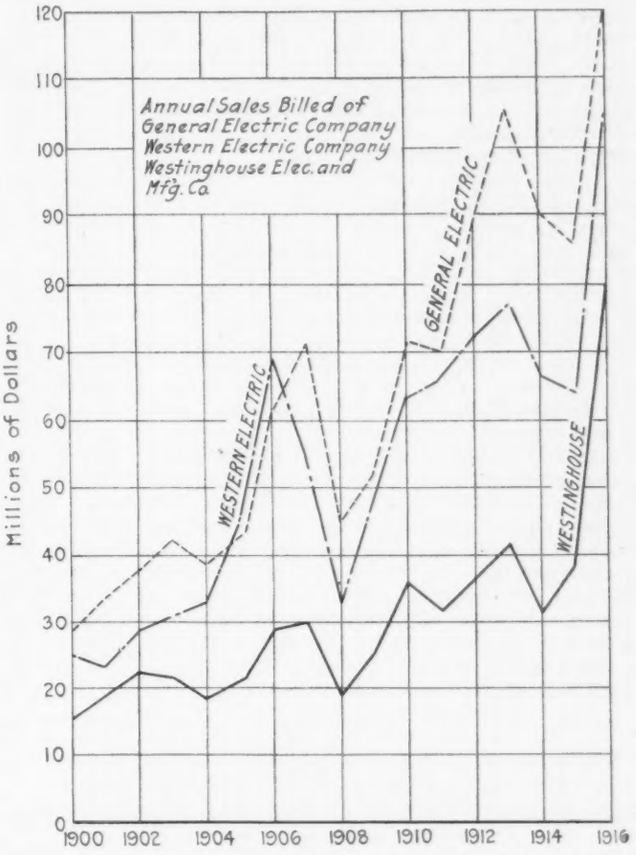
The unfilled orders for the three companies on Jan. 1, 1917, were: General Electric Company, $45,000,000; Western Electric Company, $30,000,000; Westinghouse Electric & Manufacturing Company, $30,000,000.

In comparing the 1916 figures with those of previous years it must be remembered that values and not volume of goods are here given. Prices advanced on the whole during 1916 about 35 per cent, but most of the orders delivered in 1916 were placed prior to July, thereby escaping the fall price increases. Furthermore, goods which were ordered in 1915 at the old prices were delivered in appreciable volume during 1916. For these reasons it is probable that the average increase over previous years in prices of goods delivered in 1916 was not more than 15 per cent. Therefore by subtracting 15 per cent roughly from the sales billed in 1916 figures will be obtained from which rather accurate comparisons could be drawn.

On this basis then the actual volume of business done in 1916 by the three companies was 38 per cent greater than that done in 1915 and 14 per cent greater than that done in the record year of 1913.

All electrical manufacturing plants were taxed to their utmost in 1916 and could, therefore, handle no more business than they did. However, had manufacturing space been available, had it been possible to secure sufficient stocks of raw materials and had labor been more plentiful it is difficult to say how much greater the 1916 business would have been. Certain it is that there was a demand for electrical goods equal to at least twice what it was possible to turn out.

All but about 7 per cent of the 1916 business was for domestic consumption. The foreign trade, amounting to about 7 per cent of the total, was by no means indicative of the foreign demand. Had it been possible to satisfy foreign as well as domestic demand for electrical goods it



SIXTEEN YEARS OF SALES BILLED BY THREE LARGEST DISTRIBUTORS OF ELECTRICAL GOODS

is quite probable that the 1916 sales for the entire industry would have overreached the $1,250,000,000 mark.

With the above volume of orders on the books to start off 1917, the outlook for the current year is excellent. Present indications are that the 1917 business will not fall far short, if at all, of the 1916 record.

Even should the market fall off later in the year there will be sufficient business on hand to keep the industry busy during 1917.

COPPER MARKET FIRMER

Little Inquiry and No Evidence of Desire on Part of Those Holding the Metal to Sell

Again the copper market shows an upward swing. This advance, however, is not occasioned by any volume of buying or inquiries, for there has been but little of either. It is but a technical condition that was expected after the drop from 36 cents. Holders of the red metal show no evidence of a desire to part with any quantity of their holdings. It is doubtful, however, if the price will reach much above 30 cents in this upward movement.

January copper was quoted on Tuesday at 29.5 cents

and February at 29 cents. First quarter was quoted at 29 cents, second quarter at 28.25 cents, third quarter at 26.5 and last quarter at 25.5.

WARNING SOUNDED BY WIRE MANUFACTURING COMPANY

While Prospects for the 1917 Wire Market Are Bright Buyers of Insulated Wire and Cable Are Warned to Purchase for Actual Needs Only

Speculation is running wild over the prospects for the new year. One thing, however, is certain. The first sign that the nations of Europe are ready to consider peace proposals will be accompanied by a break in the raw-materials market and a slump in the value of jobbers' supplies. This statement is well borne out by the reaction in the copper market on the news of Teutonic peace proposals. Prices of raw materials are undoubtedly inflated and will therefore tumble, not far, perhaps, for some time, when peace becomes somewhat certain.

To the electrical jobber this is causing no end of concern, and the manufacturer is likewise worried, for he must not only face the loss in his raw materials but he may have to face a period of very slow collections from the jobbers to whom he has sold large stocks on credit and from whom he has orders for large quantities of electrical merchandise now in the course of production and which will be billed at the high prices that obtained at the time of ordering.

In view of this condition the following paragraphs from the current number of *The Wire Message*, published by Habirshaw Electric Cable Company, Inc., and The Electric Cable Company, are significant.

"In the insulated wire and cable industry we find evidence of sound prosperity. Reasonable profits have made possible increased facilities and higher efficiency. Most factories are working overtime and orders are booked that cannot be delivered until well into 1917. Reports from all sections of the country indicate no curtailment of demand in the near future. Some decrease in purchasing activity that would bring demand near to maximum production, should be welcomed rather than feared. The industry as a whole has never faced a New Year with brighter prospects. It has but one thing to fear.

Warning

"When great business activity exists and supplies of all kinds are difficult to obtain, there is strong temptation to over-buy. Speculation of this kind, especially at top prices, may lead to disastrous results, though basic conditions of business may be sound. Our warning is to buy for actual needs only, and we cannot make this warning too strong. We reiterate our belief that the wire and cable industry, and business in general, faces a year of great prosperity, but it would be fatuous to believe that abnormal conditions will continue to prevail. Sooner or later there must be an adjustment to the normal. When this comes those who have bought in excess of their needs will be under strong temptation to pass along their losses by endeavoring to cancel unfilled orders and outstanding contracts. This attitude is wrong, and a much harsher term might rightly be applied to it. We are not speculating in raw materials, but are buying only to take care of orders and contracts in hand. We assume these were given us in good faith and to supply legitimate needs, and we shall insist upon the acceptance of all goods covered by such contracts and orders, under the exact terms and conditions on which they were accepted. To avoid misunderstanding we stamp all quotations and invoices as follows:

"'Owing to the extraordinary conditions which now exist, and the cost of labor and materials, all quotations are made and orders accepted with the absolute understanding that material will be taken in full quantities and without change of specifications.'"

The following local conditions are reported by the companies' branch offices:

San Francisco.—Slight falling off in business, account of price. Light and power companies hold up extension work, looking for lower prices. Conditions good but any further advance will cause decrease in demand. Jobbers pretty well covered for several months. Large jobber recently contracted for carload of insulated had to buy from eight different houses to collect carload for prompt shipment. Large building operation contemplated for next spring. Stocks of rubber insulated wire and weatherproof very low on entire coast.

Omaha.—Bright outlook. Building conditions good. No material change since last month.

Minneapolis.—Large business in sight but delay in placing same on account of high prices. Lower prices anticipated.

St. Louis.—Building operations brisk. Steady demand for wire. Principal trouble is with deliveries.

Salt Lake.—Conditions same as last month. Good demand. Can sell all the wire we can get.

Richmond.—Wire business increasing. Unable to make shipments on account of difficulty in procuring stock.

Philadelphia.—Every prospect for a very good year.

Chicago.—Little change since last month. Some low prices quoted on large orders, but prices well maintained as a rule. There is still great difficulty in securing stock promptly and in sufficient quantities.

INCREASE IN RANGE PRICES DUE TO RAW-MATERIAL COSTS

Careful Estimates Place Last Year's Sales at $2,300,000 List, While 1917 Sales at List Prices Are Expected to Total $4,750,000

The advance in list price of electric ranges to go into effect on Feb. 1, as pointed out in the ELECTRICAL WORLD for Dec. 30, was owing entirely to the advanced costs of manufacturing material and labor. The licensing arrangement with the owners of the Marsh patent provides for the payment of a royalty of such small proportions that it can in no way be held accountable for the present high prices of ranges. Manufacturing costs advanced from 20 per cent on some items to almost 200 per cent on others during 1916, and manufacturers therefore were faced with a very large output, but at a very much smaller percentage of profit.

That the advance has occurred in practically everything used, and not merely in a few parts, is evident from the following table of percentage increase which was worked out from prices quoted Jan. 1, 1916, and Jan. 1, 1917. The increases have been:

Material	Per Cent Increase
Sheet steel	196
Resistance wire	35
Asbestos covered wire and cord	81
Cut outs, fuse plugs and bushings	81
Castings	35
Screws, nuts and bolts	135
Mica	100
Asbestos products	100
Labor	20

Competent authorities seem to believe that on the whole deliveries on ranges will be better in the year 1917 than they were in 1916. This optimistic view is not occasioned by any marked improvement in the raw-material market, but is due to the fact that range manufacturers understand better the conditions they must meet. When the shortage in materials was first realized the situation was a new one to the majority. Manufacturers did not know what to promise and what not to promise. But now everyone has become accustomed to the new order of things and knows how best to meet the new conditions efficiently and effectively.

The electric range business for 1916, in spite of the fact that range salesmen were in several instances called in off the road, amounted, according to an accurate estimate, to $1,500,000 at manufacturers' net selling prices, or about $2,300,000 list prices.

It is estimated, basing the figures on raw materials which range manufacturers have already actually contracted for, that the total value of electric ranges sold in 1917 at manufacturers' net selling price will be $3,000,000, or $4,750,000 list.

Manufacturing and Industrial

Holabird-Reynolds Electric Company, Los Angeles, Cal., has changed the firm name to Graham-Reynolds Electric Company.

Electric Furnace Company of America will move to Cleveland, Ohio, following the sale of $100,000 preferred and $50,000 common stock. The company manufactures the Bailey electric furnaces which are used in heat-treating steel and in melting, heating and annealing non-ferrous metals.

Lincoln Electric Company, Cleveland, Ohio, held on Jan. 5 and 6 its annual sales convention, at which fifty of its district representatives and sales agents were present. Policies for next year were discussed and plans worked out for close co-operation with users of electric motors. The convention closed with a banquet at the Hotel Statler.

Hoover Sweeper Licensed.—Following the decision of the Circuit Court of Appeals in the Innovation case in favor of the Vacuum Cleaner Company, owner of the Kenny patent for a vacuum cleaner, the Hoover Suction Sweeper Company has made arrangements whereby the Hoover cleaner will hereafter be manufactured under a license.

Bonus for Cutler-Hammer Employees.—The shop employees of the Cutler-Hammer Manufacturing Company of Milwaukee received a Christmas present in cash on Dec. 23, and before New Year's Day a notice was posted which advised everyone of a bonus of 10 per cent of the yearly wages or salary. This bonus goes to all of the 2400 employees of this company.

Exide Battery Depots Convention.—An all-day convention of the New York distributers of Exide starting and lighting batteries was held at the Hotel Martinique, New York City, on Jan. 11, under the direction of the New York office of the Exide Battery Depots, Inc., of which F. F. Sampson is manager. The convention, which was followed by a banquet, was presided over by J. A. Gould, S. L. I. sales.

Farley Gannett, consulting engineer, Harrisburg, Pa., has changed the firm name to Gannett, Seelye and Fleming. Mr. Seelye has been a member of the firm since its organization, Aug. 1, 1915, and Mr. Fleming since February, 1916. On account of expanding business, the firm has found it necessary to change the location of its offices and after Jan. 15 will occupy offices at 204 Locust Street, Harrisburg, Pa.

Hurley Salesmen Help Estimate Factory Size.—For ten days during the early part of January all salesmen of the Hurley Machine Company were at the firm's Chicago office for a sales conference. Meetings were held in the factory as well as in the office to acquaint the men with the company's manufacturing methods. This year's meeting was more than a sales conference, for in addition to discussing sales problems of 1917 the salesmen assisted in estimating the desirable capacity for the new factory which the company will soon begin building. These salesmen's estimates were based on the business each expects to do in his territory in the future.

L. L. Fleig & Company, 212 West Austin Avenue, Chicago, Ill., for the past four years operating as a partnership, have recently formed a corporation and will continue in the same lines as heretofore, but on a more extensive scale. The company has incorporated for $30,000 fully paid, the former owners, L. L. Fleig and E. P. Fleig holding all the stock in the new concern. On May 1 the company will move to more extensive quarters at the present address, at which time an additional building will be completed. The company has confined its efforts solely to electrical insulations in the past, but intends to broaden its line to cover a general jobbing trade. The company covers the seven states of Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa and Minnesota and has branch offices at Cleveland, Ohio; Indianapolis, Ind., and Milwaukee, Wis. Announcement is also made that the company has taken on the lines of the Fibre Specialty Manufacturing Company.

Allis-Chalmers Employees to Receive Bonuses in 1917.—Each employee on the payroll of the Allis-Chalmers Manufacturing Company on Jan. 1, 1917, who continues in the employment of the company during the year will receive an extra payment of 10 per cent of his total individual earnings for the year, according to a plan outlined by President Otto H. Falk. Approximately $750,000 will be distributed during 1917 in this way. Nearly 8000 employees will be affected. The plan has been established in view of the increased cost of living, and it takes into consideration the fact that continuous service tends to make employees more valuable to the company, according to a leaflet describing the arrangements which has been sent to the entire shop organization, the office and selling forces of all works of the company.

NEW YORK METAL MARKET PRICES

	Jan. 9 Selling Prices Bid	Jan. 9 Selling Prices Asked	Jan. 16 Selling Prices Bid	Jan. 16 Selling Prices Asked
	£ s d		£ s d	
London, standard spot copper	133 0 0		130 0 0	
Prime Lake	28.25	to 28.75†	28.50	to 29.50†
Electrolytic	27.75	to 28.25†	29.25	to 29.75†
Casting	27.00	to 27.50†	27.50	to 28.00†
Copper wire base	34.25†		38.00†	
Lead	7.50		7.50	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	21.00		21.00	
Spelter, spot	9.42½	to 9.67½	9.92½	to 10.00†
Tin, straits	42.60†		44.50†	
Aluminum, 98 to 99 per cent	54.00	to 57.00	51.00	to 55.00†
OLD METALS				
Heavy copper and wire	23.00	to 23.50†	22.50	to 23.00†
Brass, heavy	14.50	to 15.50†	13.50	to 14.25†
Brass, light	11.00	to 11.50†	10.50	to 11.00†
Lead, heavy	6.50	to 6.62½†	6.37½	to 6.50†
Zinc, scrap	6.00	to 6.50†	6.50	to 6.75†

COPPER EXPORTS

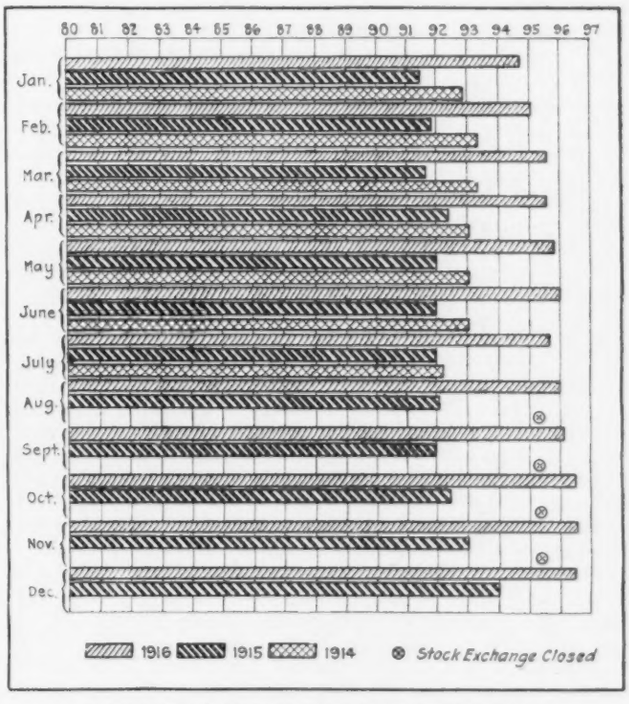
Total tons to Jan. 16 11,591

†Nominal.

ELECTRIC LIGHT AND POWER BOND PRICES IN 1916

Average Quotation on Ninety-Six Issues Showed Advance of Two and a Half Points During the Twelve Months

There was no let-up in 1916 of the pace set during the last quarter of 1915 in investment circles for electric light and power bonds. Investment bonds were never in such demand as during the past twelve months. Banking institutions and individuals had on hand large sums of idle



TREND OF BOND PRICES IN LAST THREE YEARS

money. There was by far more money waiting for investment than there were investment securities available. Several features attended this financial market. One of them, namely, that of a general tendency to permanent financing, was analyzed in the ELECTRICAL WORLD for Jan. 6. Another feature was that of very high prices.

No higher average price for electric light and power utility bonds ever existed than those quoted in 1916. On the average such bonds increased in price during the past year 2.5 points, according to the regular compilation made by the ELECTRICAL WORLD of monthly quotations on ninety-six representative issues, or over one-third of the aggregate par value of all American light and power bond issues. The result of this compilation is shown graphically for the three years 1914, 1915 and 1916. During August-December, 1914, inclusive, quotations were not obtainable owing to the closing of the stock exchanges.

The closing price of 1915 was 94 and for 1916 it was 96.5, an increase of 2.5 points. The highest price in 1916 was 96.6, registered in November. The lowest price was 94.7, registered in January.

During the seven months of 1914 prior to the war the highest average price attained by these bonds was 93.3. The lowest price after the war started was in the month following the opening of the exchange—January, 1915. It was 91.5.

Between this low price and the high of 96.6 the difference is but 5.1 points, or less than 6 per cent. It is doubtful if the bonds of any other industry can show a greater or, indeed, equal stability.

Because this is not a picked list but contains issues which are very inactive and for which there is but little demand, it is doubtful if the price will go much higher.

Corporate and Financial

Alabama Power Company, Birmingham, Ala.—A block of $2,000,000 of first mortgage 5 per cent. gold bonds due March 1, 1946, is being offered to investors.

Atlantic City (N. J.) Electric Company.—The company has been granted permission by the New Jersey Board of Public Utility Commissioners to issue bonds to the amount of $137,000 for station and system improvements.

Commonwealth Power Company of Nebraska.—A block of $750,000 of first mortgage 6 per cent. gold bonds, due March 1, 1944, is being offered at part and interest.

Iowa Southern Utilities Company, Centerville, Iowa.—An issue of $550,000 of first mortgage sinking fund 6 per cent gold bonds dated Oct. 2, 1916, and due Oct. 1, 1933, is being offered at 101 and interest.

National Carbon Company, Cleveland, Ohio.—According to an announcement made on Jan. 13, a recapitalization plan has been formulated for the National Carbon Company through which there will be greater representation in the hands of the holders of common stock. The plan provides for the incorporation of the National Carbon Company, Inc., in the State of New York, with an authorized capital of 56,000 shares, par $100, of preferred stock and 1,000,000 shares of common stock without par. The preferred stock will draw cumulative dividends at the rate of 8 per cent, payable February, May, August and November, and will be redeemable at $140 a share. Every holder of 7 per cent cumulative preferred stock in the present New Jersey corporation will be given an opportunity to exchange his securities share for share for the preferred stock of the new corporation, and every holder of common stock in the old company may exchange on the basis of one share of stock of the old company for four shares of the common stock of the New York company. The organization will be completed and the certificates ready for exchange on Feb. 1.

Texas Gas & Electric Company.—The Texas Southern Electric Company, which operates electric light and power plants at Cuero, Victoria, Beeville, Corpus Christi, Yorktown and other towns of southern Texas, has changed its name to the Texas Gas & Electric Company. It is stated that the company has adopted plans for greatly enlarging its scope of operations during the coming year.

Nova Scotia Tramways & Power Company, Halifax, N. S.—An issue of $2,500,000 of first mortgage 5 per cent gold bonds dated Dec. 1, 1916, and due Dec. 1, 1946, is being offered at 95.5 to net 5.3 per cent. There is now outstanding in addition to the issue $1,500,000 of 6 per cent cumulative preferred stock and $2,500,000 of common stock. The proceeds from the outstanding securities will provide for the acquisition of the properties of the Halifax Electric Tramway Company and the water-power rights, lands, etc., on the Gaseraux River and also for adequate working capital.

Pacific Gas & Electric Company, San Francisco, Cal.—The California Railroad Commission has issued a first supplemental opinion in the application of the Pacific Gas & Electric Company for authority to use the proceeds from the sale of its first preferred stock and its general and refunding mortgage gold bonds for additions and betterments to its plant, permitting the Pacific company to reimburse its treasury $1,068,803.86 for expenditures to Aug. 31, 1916, and to apply a balance from the sale of its stock and bonds to construction expenses after that date. Included in past expenditures within the last few months are $210,000 for raising Lake Spaulding Dam from 225 ft. to 266 ft., $235,000 for canals and conduits to return water used through the Halsey and Wise power houses to the irrigation system near Newcastle, $68,181 for a new substation at South San Francisco, $34,000 for land and rights-of-way for spilling water from the Bear River Canal, $72,425 for an office building site in Oakland, $26,000 for an office site and buildings in Berkeley, etc. The commission has also issued an order authorizing the company to issue $2,500,000 face value of its general and refunding 5 per cent bonds due Jan. 1, 1942, at not less than 90. The proceeds are to be expended under the commission's orders for the construction, completion, extension and improvement of its system. The company's program on Aug. 31, 1916, called for the expenditure upon its system of $6,431,488.18. The company had installed fixed capital prior to 1913 of $106,047,475, and since that date has brought this total of fixed capital up to $127,762,-415. The decision of the commission notes that while the company was able to sell its bonds of this same issue in 1912, when the commission had assumed jurisdiction over the company's finances, at 85 per cent of par, it is able to sell them now at 90. This is an advance of five points, which in this particular proceeding amounts to $125,000. The vice-president of the Pacific company informed the commission that the company will be able to sell these bonds at more than 90.

Wagner Electric Company, St. Louis, Mo.—The stockholders voted on Jan. 8 to increase the capital stock of the company from $2,000,000 to $5,000,000. The shares of the company will be increased from 20,000 to 50,000 of a par value of $100 per share. The increase will be met by three new rulings of the board of directors, as follows: A portion of the new shares is to be paid up from the surplus account and distributed to the stockholders pro rata for their holdings. A portion not to exceed 3000 is to be sold from time to time to employees of the company at a price of not less than $100 per share, and the proceeds, at the discretion of the directors, are to be distributed to the shareholders of record in the form of extra cash dividends. The remainder of the new shares are to be sold from time to time to shareholders pro rata at par or distributed in the form of stock dividends in the manner outlined.

New Utility and Industrial Companies

The Chatham Electric Motor Corporation has been incorporated with a capital stock of $10,000 to manufacture and deal in electric motors and other vehicles. The incorporators are: A. Kislik, S. and H. Lippman, 212 North Vernon Avenue, Arverne, N. Y.

The Boehm Surgical Instrument Corporation of Rochester, N. Y., has been incorporated by A. Butler, G. J. Boehm and F. P. Hoffman, 129 Aberdeen Street, Rochester, N. Y. The company is capitalized at $5,000 and proposes to manufacture electrically lighted surgical instruments, appliances, etc.

The Efficiency Turbine Company has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $300,000, for the purpose of manufacturing engines, dynamos, etc. The incorporators are: G. Carl Scheck, Frederick Camer of New York, N. Y., and Kellogg Sherwood of Brooklyn, N. Y.

The Buckeye Hydro-Electric Company of Cincinnati, Ohio, has been chartered with a capital stock of $25,000 by E. O. Dana, Robert P. Gillham, Frank L. Garrison, Fremont Hill and Willis G. Durrell.

The Ohio Hydro-Electric Company of Ashtabula, Ohio, has been incorporated by F. R. Garver, Mary R. Garver, B. C. Blakeslee, E. C. Brakak and Arthur Rinto. The company is capitalized at $10,000.

The Acme Power Company of Toledo, Ohio, has been incorporated with a capital stock of $25,000. The incorporators are: F. J. Derge, C. E. Murray, M. C. Seeley, A. C. Van Driesen and W. H. Torrey.

The Magnet Manufacturing Company of St. Louis, Mo., has been chartered with a capital stock of $10,000 to manufacture and deal in electrical appliances. The incorporators are: I. Korach, L. F. Korach and M. D. Frumberg.

The Binghamton (N. Y.) Motor Car Company has been incorporated by P. R., R. W. and W. G. Faatz of Binghamton, N. Y. The company is capitalized at $50,000 and proposes to manufacture autos, electrical apparatus, garages, etc.

The Electrograph Company of Kansas City, Mo., has been incorporated with a capital stock of $1,000,000 by J. F. Rudd, A. L. Landsberg and M. T. Miller. The company proposes to deal in electric advertising and electrical supplies.

The Crombie Process Corporation has been incorporated with a capital stock of $100,000 by W. E. Richards, B. B. Crombie and E. Kemble of Rye. The company proposes to do a general electrical and metallurgical engineering business.

The Michigan Porcelain Insulator Company of Hastings, Mich., has been incorporated with a capital stock of $25,000. The officers are: E. Tyden, president; R. B. Messer, vice-president; W. W. Peck, treasurer, and Albert L. Grainger, secretary.

The Simplex Ray Corporation of New York, N. Y., has been incorporated by Arthur W. Britton, Samuel B. Howard and L. H. Gunther, all of New York, N. Y. The company is capitalized at $5,000 and proposes to manufacture electrical machinery, especially X-ray apparatus.

The Ford Instrument Company of New York, N. Y., has been incorporated by J. R. Bredhuad, J. B. Goldsborough and H. C. Ford, 290 Broadway, New York City. The company is capitalized at $250,000 and proposes to manufacture mechanical and electrical machines and devices.

The Stoneware Electric Stove Company of Dover, N. J., has been chartered with a capital stock of $50,000 to manufacture electric stoves and electrical devices. The incorporators are: Arthur O. Christensen, John L. Sullivan of Dover, and William Taylor of Plainfield, N. J.

The Ritter Illuminating & Manufacturing Company of St. Catherines, Ontario, Can., has been incorporated with a capital stock of $75,000 to manufacture electrical apparatus, appliances, lamps, etc. H. Karlritter, 825 Linwood Avenue, Niagara Falls, N. Y., is representative.

The Hawkes-Ives Corporation of Brooklyn, N. Y., has been incorporated with a capital stock of $10,000 by R. C. Ream, A. E. Ives, Jr., and W. M. Hawkins, 231 Hancock Street, Brooklyn, N. Y. The company proposes to manufacture electrical appliances and do a general contracting business.

The Old Dominion Power Company of Norton, Va., has been incorporated to do a light and power business. The maximum capital stock is placed at $500,000, and the minimum $100,000. The officers are: D. Terpsrts of Dorchester, Va., president, and W. W. Kemp of Norton secretary and treasurer.

The Commercial Utilities & Manufacturing Company of Worcester, Mass., has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical devices and supplies. The officers are: Linwood M. Erskine, president and treasurer; Alfred J. Holm, vice-president, and C. H. Shedd, clerk.

The Lake Shore Electric Company of Henderson, N. Y., has been organized to take over the lighting system in Henderson and Henderson Harbor, owned by George N. Nilson. C. W. Valentine of Watertown, N. Y., and M. B. Steele, president and manager of the Adams (N. Y.) Electric Light Company, are interested in the new company.

The United States Truck Corporation has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $5,000,000 and proposes to manufacture all kinds of motor-driven vehicles. The incorporators are: Robert W. Crawford of Streator, Ill.; Charles H. McDermott and Warner A. Ross of Chicago, Ill.

The Klett Manufacturing Company of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture scientific, surgical and electrical appliances. The incorporators are: G. L. J. Sorenson, 539 East Eighty-third Street; M. Sorenson, 177 East Eighty-seventh Street, and J. Werner, 301 East Twenty-ninth Street, New York, N. Y.

The H. L. Wheelden Company of Bangor, Me., has been organized with a capital stock of $10,000 to do a general contracting business in connection with the installation of appliances, fittings, etc., used in the transmission of electricity, gas, gasoline, steam and water. The officers are: Harry L. Wheelden, president; Cora I. Morrison, clerk and treasurer, both of Bangor.

Trade Publications

Motor Trucks.—Sterling motor trucks are illustrated and described in a folder issued by Lewter F. Hobbs, Norfolk, Va.

Fire Detection.—"Fire Detection" is the title of a booklet issued by the Fire Detecting Wire Company of 101 Park Avenue, New York City.

Feed Water Regulators.—The Ray Manufacturing Company of Louisville, Ky., has issued a bulletin descriptive of its continuous feed-water regulators.

Railway Motors.—The General Electric Company of Schenectady, N. Y., has prepared bulletin No. 44,417 descriptive of its GE-258 ventilated commutating-pole railway motors.

Electric Heaters. — The Majestic Electric Development Company, 428 O'Farrell Street, San Francisco, Cal., has prepared a leaflet descriptive of its "Majestic" No. 7 electric heaters.

Chains.—"A Chain of Evidence" is the title of publication No. 15 issued by the Morse Chain Company of Ithaca, N. Y. This bulletin deals with power drives of less than 100 hp. each.

The Vanadium-Alloys Steel Company, Pittsburgh, Pa., has for distribution a folder descriptive of Vasco-Marvel, a semi-high-speed steel. This folder contains much information of interest, together with the High-Speed Steel Standard Classification of Extras adopted July 22, 1915.

The Youngstown Sheet & Tube Company, manufacturers of iron, steel, and other products, Youngstown, Ohio, have issued a very attractive calendar for 1917. This calendar contains twelve large two-color photographic views showing the processes used in their works in the manufacture of pipe and other products.

Batteries.—The "Iron-Clad Exide" battery for storage-battery industrial trucks and tractors is well described and illustrated in bulletin No. 160 recently issued by the Electric Storage Battery Company of Philadelphia. Numerous illustrations showing actual performances of these storage-battery tractors are shown.

Die Casting.—"Creating an Industry" is the title of a carefully prepared and well illustrated book that is now being distributed by the Doehler Die Casting Company of Brooklyn, N. Y. This book goes into the history of casting metals starting with the early Egyptian methods up to the present ones used by the Doehler Company.

Instruments.—The Precision Instrument Company of Detroit, Mich., has issued a loose-leaf catalog entitled, "Precision." This catalog contains bulletins on CO_2 Combustion Recorders, "Pico" Gages, Indicating and Recording Precision Gages, Precision Micrometer Gages, U Type Gages, Precision Efficiency Kit, Gas Collectors, and Water Meters.

New England

MONTPELIER, VT.—The Montpelier & Barre Light & Power Company is contemplating the erection of a 2300-volt, single-phase transmission line from North Montpelier to East Calais, 4.5 miles, to furnish electricity for street and residential lighting. The company is now building a high-tension line to connect its No. 3 and No. 5 stations.

HAVERHILL, MASS.—Preparations are being made by the Haverhill Electric Company for the installation of a 6250-kva. turbo-generator.

WORCESTER, MASS.—The Worcester Electric Light Company has accepted the orders adopted by the Board of Aldermen authorizing the company to erect transmission lines on Vernon, Paine, Kenilworth, Greenwood Streets and Malvern Road.

NEW HAVEN, CONN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 31 for the installation of three electric elevators in the United States post office at New Haven. For details see proposal columns.

Middle Atlantic

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company contemplates the erection of a substation on Noyes Island for the distribution of electricity in the downtown district.

INDUSTRY, N. Y.—Bids will be received by Mrs. Warham Whitney, president of board of managers, New York State Agricultural and Industrial School, Industry, until Feb. 13 for construction, plumbing and drainage, and electric work for new cottage for boys at above named school. Drawings and specifications may be consulted at the school; at the New York office of the Department of Architecture, Room 1224, Woolworth Building, and at the Department of Architecture, Capitol, Albany. Copies of plans may be obtained at the Department of Architecture, Albany. Lewis F. Pilcher is state superintendent.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York City, until Jan. 29 for tool equipments, and electric wiring for same, for shops (duplicate school plan) in Public School 43, Brown Place, 135th and 136th Streets, borough of the Bronx. Blank forms, plans, etc., may be obtained or seen at the above office.

NEW YORK, N. Y.—The Public Service Commission has awarded contract for the installation of third-rail, track bonding and miscellaneous electrical equipment on the Culver line of the New York Municipal Railway Corporation to Lupfer & Remick of Buffalo, at $101,000.

RENSSELAER, N. Y.—The Albany Southern Railroad Company of Hudson has submitted a proposal to the Rensselaer Water Company offering to supply electricity to operate the water works plant. James E. Hewes of Hudson is general manager of the railroad company.

UTICA, N. Y.—The City Council has awarded the Utica Gas & Electric Company a contract for lighting the streets of the city for a period of five years. The new contract provides for the installation of ornamental magnetite arc lamps in the center of the city and nitrogen Mazda tungsten lamps in various locations in other parts of the city. The specifications under the new contract call for the installation of much new apparatus.

ALLENTOWN, PA.—Bids will be received at the office of A. L. Reichenbach, Mayor, 39 North Seventh Street, Allentown, Pa., until Jan. 30 for furnishing and installing two 400-hp. boilers in the pumping station in the city of Allentown. Specifications may be obtained upon application to the superintendent of parks and public property, division of water.

NORRISTOWN, PA.—The Counties Gas & Electric Company has purchased the property at Swede and DeKalb Streets, in connection with the proposed additions to its electric and gas plants.

PHILADELPHIA, PA.—The Bureau of Water is considering the installation of new electrical equipment to operate the Roxborough pumping station, to replace the present steam equipment.

PHILADELPHIA, PA.—A large power plant will be erected in connection with the proposed improvements and extensions at the League Island Navy Yard. The cost of the entire work is estimated at about $6,000,000.

PHILADELPHIA, PA.—The construction of a high-speed electric railway between Frankford and Somerton sections of the city

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

for which $1,200,000 has been appropriated, is under consideration by the Mayor and the City Council.

PHILADELPHIA, PA.—Cramp & Company, Denckla Building, Philadelphia, have been awarded the general contract for the construction of power house and loft building, eight stories, 121 ft. by 236 ft. for Hale & Kilburn, to cost about $450,000. C. W. Young, Eighteenth Street and Lehigh Avenue, is in charge of the work.

PITTSBURGH, PA.—The Pennsylvania Railroad Company, it is reported, contemplates the construction of an electric power plant at Kiskiminetas Junction, at a cost of about $400,000. The proposed plant would supply electricity for lighting and heating all stations between Pittsburgh and Oil City and to operate the switch and signal systems, etc.

POTTSVILLE, PA.—The electric power plant and car barns of the Eastern Pennsylvania Light, Heat & Power Company at Palo Alto, recently damaged by fire, causing a loss of about $500,000, will be rebuilt immediately. The Lehigh Navigation Electric Company of Hauto is now furnishing energy to the company for distribution in the territory served by the plant.

ATLANTIC CITY, N. J.—The Board of Utility Commissioners has granted the Atlantic City Electric Company permission to issue $137,000 in bonds, the proceeds to be used for improvements to power station and system.

CAMDEN, N. J.—Plans have been approved by the Board of Freeholders for the erection of power plants at the county asylum and the county tuberculosis hospital.

JAMESBURG, N. J.—Plans are being considered by the Jamesburg Water Company for the installation of a new water wheel to increase the output of the electric-lighting plant.

NEWARK, N. J.—Bids will be received by the public building committee of the Common Council until Jan. 30 for work at the City Hospital. Fairmount Avenue and Bank Street, Newark, including electric wiring, electric fixtures, ice-making plant, vacuum cleaning and heating and ventilating. Messrs. Conklin & Convery, 665 Broad Street, Newark, are architects.

NEW BRUNSWICK, N. J.—Bids will be received by the county building committee, County Record Building, New Brunswick, until Jan. 25 for furnishing and installing a pumping station and lighting plant at the new county workhouse in North Brunswick Township. Plans and specifications are on file in the office of Alexander Merchant, 363 George Street, New Brunswick, architect.

ORANGE, N. J.—The installation of a garbage reduction plant, to be operated by electricity, at the municipal power station is under consideration by the City Commission.

PENNS GROVE, N. J.—The Council has approved the installation of new 400 cp. lamps at street intersection in the business district. The street-lighting service is furnished by the Penns Grove Electric Light, Heat & Power Company.

TITUSVILLE, N. J.—Arrangements have been made by the Township Committee with the Public Service Electric Company for the installation of street lamps in Titusville and Washington's Crossing.

TRENTON, N. J.—Mayor Donnelly has engaged F. W. Ballard, electrical engineer, Cleveland, Ohio, to make investigations of the local water power properties and also as to the feasibility of utilizing them for the installation of hydroelectric plants to be owned and operated by the municipality.

TRENTON, N. J.—Bids will be received by Henry B. Kummel, acting director, department of conservation and development, until Feb. 2 for the erection of a laboratory building for the department, including electrical work, heating and equipment. Plans are on file at the office of the Department of Charities and Corrections, State House, Trenton.

WESTMONT (P. O. CAMDEN), N. J.—Plans have been submitted to the Township Committee by the Public Service Electric Company for improvements to the street-lighting system, which provide for the installation of new lamps.

NEWARK, DEL.—Plans are being considered by the Town Council to increase the output of the electric-light plant and waterworks system to meet the increasing demand for service.

BALTIMORE, MD.—The Western Maryland Railway Company, it is reported, has under consideration the use of electrically operated trains on its grades over the Blue Ridge Mountains.

GRANTSVILLE, MD.—Work has begun on the installation of an electric-lighting system in Grantsville.

HARTLAND, W. VA.—The Hartland Power Company, recently incorporated with a capital stock of $700,000, is planning to build a power plant to furnish electricity to the coal mines operated by the lessees of the Hartland Colliery Company, located near Hartland. W. S. Barstow & Company, 50 Pine Street, New York, N. Y., will have charge of the work. In the same territory the General Gas & Electric Company has taken an option on a lease of 600 acres of coal land, containing 10,000,000 tons of coal. W. S. Barstow, 50 Pine Street, New York, N. Y., is president of the General Gas & Electric Company.

RONCEVERTE, W. VA.—Preparations are being made by the Virginia-Western Power Company of Clifton Forge, Va., for the construction of a new steam turbine plant, equipped with automatic stokers and complete coal-handling apparatus, near Ronceverte. Work will begin very soon on the proposed plant.

CLIFTON FORGE, VA.—The Virginia-Western Power Company will begin work in the near future on the erection of a steam turbine plant, to be equipped with automatic stokers and complete coal-handling devices. This plant will be located in the vicinity of Ronceverte, W. Va. The company has purchased material to complete its transmission lines from Alderson to Hinton and Avis, W. Va., where it has 50-year franchises and contracts with the Chesapeake & Ohio Railway Company. The line, it is expected, will be completed about April 15, and the new power house early next year. A. C. Ford is secretary and treasurer.

DORCHESTER, VA.—The Old Dominion Power Company of Norton contemplates the erection of a 22,000-volt transmission lines (50 miles long) to Norton, Wise, Coeburn and Glamorgan. Other improvements are under consideration by the company.

NORFOLK, VA.—The Virginian Railway Company, it is reported, is making investigations with a view of utilizing electric locomotives on its railroad between Elmore and Clark's Gap for the handling of heavy coal trains.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, District Building, Washington, D. C., until Jan. 22 for furnishing telephone and signal cables. Specifications, etc., may be obtained upon application to the office of the purchasing officer, Room 320 District Building.

WASHINGTON, D. C.—Bids will be received by the Board of Awards, Department of Agriculture, Washington, D. C., until Jan. 30, for furnishing 14 motors, ranging from 2 to 20 hp. for alternating current, variable speed types, to be delivered at Summerland, Cal. Bids will also be received at the same time and place for three air blowers of 4000 cu. ft. capacity, directly connected to electric motors. Blank forms and specifications may be obtained from the chief clerk of the department.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Philadelphia, Pa., Schedule 626—two forced draft blowers, four evaporators; Schedule 635—one feed water heater; Schedule 634—two torsion meters; Schedule 627—miscellaneous tungsten tool steel, Washington, D. C., Schedule 629—40 sets semi-circular corrector magnets. Various—Schedule 629—40 magnetic compass readers; Schedule 627—miscellaneous carbon tool steel. Brooklyn, N. Y., Schedule 633—300 snap switches; Schedule 625—miscellaneous composition pipe fittings. Brooklyn, N. Y., and Mare Island, Cal., Schedule 628—miscellaneous interior communication armored cable; miscellaneous leaded and armored interior communication cable; miscellaneous plain interior communication cable; miscellaneous armored telephone cable; miscellaneous leaded and armored telephone cable; miscellaneous plain telephone cable; miscellaneous leaded and armored interior communication conductors; miscellaneous single and twin leaded and armored conductors; miscellaneous single and twin plain conductors; miscellaneous twin armored conductors; miscellaneous wire for illuminating outfits. Boston, Mass., Schedule 625—miscellaneous steel pipe, 540 lb. copper tubing. Applications for proposal blanks should designate the schedule desired by number.

North Central

DETROIT, MICH.—Owing to the decision of the Public Lighting Commission not to supply electrical service to the county buildings after Dec. 31, the Wayne County board of auditors has decided to install an electric power plant to light the building. As direct current will be supplied by the new plant it will be necessary to change the motors now in use, which are for alternating current.

GLADSTONE, MICH.—The Board of Fire and Water Commissioners contemplates the erection of 5 miles of 6600-volt transmission line and the installation of electrically driven pumps of 100,000 gal. capacity. J. R. Mackin is superintendent of the municipal electric and water systems.

ATHENS, OHIO.—Suits have been filed by the Buckeye Hydro-Electric Company for the condemnation of property for use in its project of constructing a large hydroelectric power plant in this vicinity. W. G. Burrell, an attorney of Cincinnati, is acting for the company.

CANTON, OHIO.—The Public Utilities Commission has authorized the Canton Electric Company to take over the Sunnyside Electric Company of Wheeling, W. Va., and the Ohio Light & Power Company of Newark, Ohio, and form the Central Power Company, which was given permission to issue $2,760,000 in capital stock, to be exchanged for the capital stock of the merged companies. The Central Power Company will operate the large plant now under construction on the Ohio River, near Wheeling, W. Va., and also the plants at Wheeling and Steubenville, Ohio.

CHILLICOTHE, OHIO.—The City Council has awarded the Chillicothe Electric Railroad, Light & Power Company contract for lighting the streets of the city for a period of ten years. The new contract provides for considerable extension of the service.

CINCINNATI, OHIO.—Plans have been perfected by the Main Street Association for the installation of an ornamental street-lighting system on Main Street, from Fourth Street to McMicken Avenue (about 16 blocks). A. G. Rist is chairman of committee.

CLEVELAND, OHIO.—Bids will be received by the clerk of the board of education of the city school district of the city of Cleveland, Room 105, School Headquarters, Rockwell Avenue and East Sixth Street, Cleveland, until Jan. 29 for electric wiring in Tremont School Annex as follows: (1) 15 class rooms, auditorium, etc.; (2) 17 class rooms, etc., auditorium omitted. Drawing, specifications, etc., may be obtained upon deposit of $5 at the office of the division architect, Room 102, School Headquarters.

JAMESTOWN, OHIO.—Negotiations have practically been closed for the purchase of the property of the Jamestown Electric Light Company by the Dayton (Ohio) Power & Light Company.

MILFORD, OHIO.—The Little Miami River Light & Power Company, it is reported, has applied to the City Council for certain rights along the Little Miami River within the corporate limits of the village for the construction of dams and other improvements. Fourteen dams, it is said, will be built between Plainville and Morrow.

ST. MARY'S OHIO.—Plans are being prepared by the Froehlich & Emery Engineering Company, Second National Bank Building, Toledo, for rebuilding the municipal electric-light plant and water-works system in St. Mary's, to cost about $60,000. The work will include the installation of electrically-driven pumps of 5000 gal. per minute capacity each, a 600-kw. generator; also the installation of an ornamental street-lighting system.

SPRINGFIELD, OHIO—Extensive additions and improvements are contemplated by the Springfield Light, Heat & Power Company to its power plant between Center and Fisher Streets off of Rockaway Street. Definite plans have not as yet been decided upon. The company recently purchased a tract of land adjoining its plant.

CAVE CITY, KY.—The electrical franchise offered for sale by the city has been purchased by the Kentucky Utilities Company of Lexington. Arrangements will be made by the company to maintain a 24-hour service.

LOUISVILLE, KY.—The Kentucky Traction & Terminal Company contemplates improvements to its system involving an expenditure of about $200,000, which will include the installation of a new 4000-kw. generator and nine voltage regulators. S. H. Dailey is general manager.

STANTON, KY.—Bonds to the amount of $15,000 have been voted for the installation of a municipal electric-light plant.

ANDERSON, IND.—The Board of Works has authorized City Engineer Funk to prepare plans for an addition to the boiler room of the municipal electric plant to provide space for two new 500-hp. boilers, recently purchased; an addition will also have to be erected to the main part of the power station to make room for the new 5000-kw. turbo-generators, recently ordered. E. Burke, superintendent of the municipal electric plant, has also been authorized to purchase wire, poles, etc., for a new high-tension feed wire to the plant of the Remy Electric Company.

CLINTON, IND.—The properties of the Clinton (Ind.) Electric Light & Power Company and the Sullivan (Ind.) County Electric Company, located in Clinton, Dana, Farmersburg, Shelburn, Sullivan, Hymera, Coalmont and Jacksonville have been sold to the Wabash Valley Electric Company of Clinton.

KOKOMO, IND.—The Indiana Railways & Light Company, it is reported, contemplates the construction of a new terminal station in Kokomo.

CHICAGO, ILL.—Announcement has been made at the University of Chicago of plans for the erection of one of the largest wireless telegraph plants on the Great Lakes. The antennae of the new wireless station will be 250 ft. long, and will stretch from the top of the Ryerson tower, 100 ft. above the ground, to the top of Mitchell tower.

DANVILLE, ILL.—The Danville Street Railway & Light Company is planning to install a 5000-kva. General Electric turbine. J. E. Johnson is general superintendent.

FAIRFIELD, ILL.—The Commissioners of Wayne County are contemplating the installation of a power plant in the county building in Fairfield.

ORION, ILL.—Bids will be received by the Village Board until Feb. 5 for the purchase of the power house and distribution system in the village of Orion and for supplying electricity for street-lighting and commercial purposes. A. E. Fehman is village clerk.

PEKIN, ILL.—The installation of an ornamental street-lighting system in Pekin is under consideration.

SPRINGFIELD, ILL.—Bids will be received by the Board of Administration, Capitol Building, Springfield, Ill., until Jan. 22, for improvements at institutions named: Installation of a complete switchboard and wiring in power house at the Alton (Ill.) State Hospital. Installation of an overhead electric transmission line at the Watertown State Hospital, East Moline, Ill. Plans and specifications may be obtained upon written application to James B. Dibelka, state architect, 130 North Fifth Avenue, Chicago, Ill.

AMBERG, WIS.—An option, it is reported, has been obtained on the Davis Falls water power site for the purpose of constructing a hydroelectric power plant to supply electricity in Amberg and several neighboring towns.

JANESVILLE, WIS.—Plans, it is reported, have been prepared for the construction of a power plant and flume for the Doty Manufacturing Company, 302 North Main Street, Janesville.

EAU CLAIRE, WIS.—The holdings of the Jim Falls Power Company have been purchased by the Wisconsin-Minnesota Light & Power Company, which will enable the latter company to double the output of its plant.

IOLA, WIS.—The plant and holdings of the Iola Electric Light & Power Company has been purchased by W. N. Albertson & Company of Milwaukee, which contemplate various changes to the commercial and street-lighting systems. W. N. Albertson & Company are also contemplating taking over various utilities in Northern Wisconsin. W. N. Albertson is engineer.

PITTSVILLE, WIS.—Plans are being considered by Chester Colt of Poysippi for the installation of a hydroelectric plant to supply electrical service in Pittsville.

RACINE, WIS.—The Wisconsin Telephone Company contemplates the erection of a central station, to cost about $100,000.

AKELEY, MINN.—The establishment of a municipal electric-light plant in Akeley is reported to be under consideration.

NORTH REDWOOD, MINN.—The local electrical distribution system of the Northern States Power Company has been purchased by the Redwood Falls (Minn.) Light & Power Company. A. C. Burmeister is manager of the Redwood Falls company.

SAUK CENTER, MINN.—Bonds to the amount of $50,000 have been voted for the installation of a municipal electric-lighting plant in Sauk Center.

WAUBUN, MINN.—The contract for installation of an electric-lighting system has been awarded to L. A. Faucher of Waubun.

CEDAR RAPIDS, IOWA.—Plans are being prepared by the Iowa Railway & Light Company for the construction of a power house on North Sixth Street East, to cost about $20,000. J. D. Wardle is engineer for the company.

CEDAR RAPIDS, IOWA.—Bids will be received by E. A. Higby, Granby Building, Cedar Rapids, for the construction of an eight-story store and office building to be erected at Second Street and Third Avenue, including electric wiring, steam heating, plumbing, two electric elevators, automatic sprinkler, coal chute, dumb waiters, fan ventilators, etc. The cost of the building is estimated at from $150,000 to $200,000. Ernest Kennedy, Essex Building, Minneapolis, Minn., is architect.

FAIRFIELD, IOWA.—A special election will be held Jan. 30 to submit to the voters the proposal to grant an electric-lighting franchise.

IOWA CITY, IOWA.—The contract for electric wiring for three school buildings in Iowa City has been awarded to the Midland Electric Company of Mason City, at approximately $5,000. An item published in the issue of Jan. 13 stated that the Capitol City Electric Company of Des Moines had submitted the lowest bid, at $11,781.

MARNE, IOWA.—The installation of a municipal electric-light plant in Marne is under consideration.

MAQUOKETA, IOWA.—Bonds have been voted for the maintenance of a municipal electric-light plant in Maquoketa.

SERGEANTS BLUFF, IOWA.—Bids will soon be asked by the Board of Education of Sergeants Bluff for the construction of a school building (to cost about $75,000), including electric wiring, steam heating, plumbing, etc. William L. Steele, United Bank Building, Sioux City, Iowa, is architect.

WEST BURLINGTON, IOWA.—Bonds to the amount of $11,000 have been voted for the installation of a water-works system. The use of electrically-driven pumps is under consideration.

LEBANON, MO.—The city of Lebanon has granted a franchise to J. B. Quigley and H. D. Hallett to supply electricity for lighting, heating and pumping water. Energy is to be supplied from the hydroelectric power plant to be developed on the Niangua River, within 30 miles of Lebanon.

RICHMOND, MO.—The Missouri Gas & Electric Service Company expects to purchase a 100-hp. boiler this summer to replace its boilers now in use.

ABERDEEN, S. D.—The Dakota Central Telephone Company contemplates the construction of a new telephone exchange in Aberdeen in the spring, to cost about $75,000.

VEBLEN, S. D.—Bids will be received by C. A. Sasse, clerk of independent school district No. 1, Veblen, until Feb. 7 for the complete installation of mechanical equipment for the new grade and high school building at Veblen. Copies of plans and specifications may be obtained upon application to Gilbert R. Horton, Citizens' Bank Building, Jamestown, N. D., upon deposit of $10, of which $5 will be refunded upon return of plans.

DAYKIN, NEB.—Bids will be received by J. O. Greenawalt, city clerk, Daykin, until Jan. 24 for the construction of an electric-light plant.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company, it is reported, will let contract early in the spring for the construction of an extension from Lincoln to Omaha, via Havelock, Greenwood, Ashland, Papillion and South Omaha, a distance of 50 miles.

SUTHERLAND, NEB.—The village of Sutherland, it is reported, is asking for bids for the construction of a power house for the municipal electric-light plant. The cost is estimated at $1,400.

FORT SCOTT, KAN.—At an election held recently the proposal to issue bonds to establish a municipal electric-light plant was carried.

HAVANA, KAN.—Steps have been taken to organize a company to construct and operate an electric-light plant and ice factory. The company will be known as the Havana Light & Power Company.

PRATT, KAN.—The city of Pratt expects to purchase immediately one 300 to 350-hp. boiler and stack for the municipal plant. E. W. Brown is superintendent.

TOPEKA, KAN.—Bids will be received by D. Lester, city clerk, South Topeka, until Jan. 25 for the installation of an ornamental lighting system on South Topeka Avenue.

Southern States

COLUMBIA, S. C.—The Storage Battery & Electric Company, recently incorporated, contemplates operating a storage battery re-forming station to build and rebuild storage batteries, and operate an electrical service station, etc. The company is capitalized at $10,000. R. C. McCreight is president and general manager.

NORCROSS, GA.—The Georgia Railway & Power Company of Atlanta has begun work on the construction of a transfer station near its transmission line and the Norcross substation. The company is planning to extend its transmission lines to Stone Mountain to supply electricity there and also to intermediate towns.

VALDOSTA, GA.—Extensive improvements are contemplated to the cold storage plant and power station of the Valdosta Lighting Company, involving an expenditure of about $100,000. W. E. Eager is general manager.

ST. AUGUSTINE, FLA.—The City Commissioners have awarded the St. Johns Light & Power Company a contract for street-lighting for a period of five years. Under the terms of the new contract 512 new incandescent lamps will be substituted for the 44 arc lamps and 248 incandescent lamps now in use.

COLUMBIA, TENN.—The capital stock of the Columbia Water & Light Company has been increased to $100,000.

BIRMINGHAM, ALA.—The Alabama Power Company is reported to have sold $2,000,000 additional bonds, the proceeds to be used for the construction of a new 70,000-hp. steam power plant on the Black Warrior River and increasing the power plant at Lock 12 on the Coosa River by 15,000 hp.; also the extension and completion of the company's distribution system, consisting of 675 miles.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company, it is reported, will begin work at once on the construction of an extension of its railway from South Fort Smith to Van Buren, a distance of about 12 miles.

ARDMORE, OKLA.—The Ardmore Electric Railway Company contemplates the construction of about 30 miles of new railway line this year.

CHARLESTON, OKLA.—The City Council is reported to have granted the Peoples Service Company of Muskogee a franchise to supply electricity in Charleston for a period of 25 years.

MOORELAND, OKLA.—Bonds to the amount of $10,000 have been voted for the installation of an electric-lighting system.

WETUMKA, OKLA.—The city of Wetumka has issued $40,000 in bonds for improvements to electric-light plant, water works and sewer system.

AMARILLO, TEX.—The installation of a municipal electric-light plant and waterworks system in Amarillo is under consideration.

BEAUMONT, TEX.—Plans are being considered by the Beaumont Traction Company for the erection of an electric transmission line between Beaumont and Port Arthur, and also increasing the ouput of the two power plants.

BROWNWOOD, TEX.—The West Texas Telephone Company contemplates increasing its capital stock from $100,000 to $400,000, the proceeds to be used for extensions to its toll lines and improvements to its exchanges in a number of towns.

COLLEGE STATION, TEX.—All bids submitted for the erection of a power plant for the Agricultural and Mechanical College at College Station have been rejected by the board. The cost of the plant was estimated at $25,000. Bids were rejected for the reason that none came within the appropriation. John F. Guion of Ballinger is president of the board.

DALLAS, TEX.—Recommendation has been made for the installation of an additional generating unit to the power plant that supplies electricity for lamps and motors for the county court house, criminal courts building and the Oak Cliff and the Commerce Street viaducts, at a cost of approximately $12,000.

DUBLIN, TEX.—The City Council has granted the Texas Power & Light Company of Dallas a 50-year franchise to construct and operate an electric system in Dublin. The company has purchased the electric plant of the Central Texas Power & Transmission Company at Hico, which supplies electrical service in Dublin.

EL PASO, TEX.—The El Paso Electric Railway Company has increased its capital stock from $2,500,000 to $3,500,000, the proceeds to be used for improvements now being made and future extensions, including the installation of a substation for supplying energy for the Government Hill and Fort Bliss lines. The cost of the underground conduit system in the business district is estimated at $300,000. H. S. Potter is manager.

HUBBARD, TEX.—Bids will be received by the Union Light & Power Company of Hubbard until Feb. 1 for furnishing 43,000 ft. No. 10 double-braided, waterproof, insulated copper wire; one 200-hp. tubular steel cased boiler, 125 lb. pressure; 80-ft. stack of No. 12 iron front, etc., complete; one 200-ft., ⅝-in. diameter steel cable rope; one 3-hp., 220-volt motor-generator set; one flange union for 2 15/16-in. diameter shaft, four post flanger oiling boxes for 2 15/16-in. steel drive shaft; one 36-in. by 72-in. marble switchboard, equipped with all devices necessary to handle 2300-volt, alternating current, oil switches, etc. W. A. Bass is president.

Pacific States

MONROE, WASH.—Application has been made to the City Council by Frank A. Steel, attorney, Mutual Lift Building, Seattle, representing Eastern capital, for a franchise to construct and operate waterworks system and power plant in Monroe. Power site has been secured on Lake Fontal, 3 miles distant. The plans provide for an expenditure of from $125,000 to $150,000, and include a pipe line of 1,250,000 gal. capacity per day.

OLYMPIA, WASH.—The City Council has granted the American District Steam Company of Tonowanda, N. Y., a 25-year franchise to operate a combined steam heating and electric plant in Olympia. Work will not begin on the proposed plant until next spring.

RITZVILLE, WASH.—The Washington Water Power Company of Spokane contemplates rebuilding its local distribution system, which will include new pole lines, transformers and lighting system.

SEATTLE, WASH.—The Board of Public Works has awarded the contract for the annual supply of lamps for the municipal lighting department to the Pacific Lamp & Supply Company of Seattle, to cost approximately $100,000.

SOUTH CLE ELUM, WASH.—The town of South Cle Elum has petitioned the Commissioners of Kittitas County for permission to erect and maintain electric transmission lines over certain highways and thoroughfares in and near the town for a term of 50 years. A bond issue of $5,000 was recently voted for the installation of an electric-lighting system.

CANBY, ORE.—The property of the Mollalla Electric Company, owned by Miles C. Moore of Walla Walla, Wash., serving Canby and Canby River points with electricity, has been sold for a consideration of $75,000.

EUGENE, ORE.—As a result of the voluntary placing of the Northern Idaho & Montana Power Company of Sandpoint, Idaho, in the hands of a receiver in Spokane, Wash., extensions and improvements involving an expenditure of between $300,000 and $400,000 will be made to the properties of the Oregon Power Company in the Willamette Valley. Both companies are controlled by the H. M. Byllesby Company of Chicago, Ill.

HOOD RIVER, ORE.—Preliminary work has begun by the Pacific Power & Light Company of Portland on the erection of high-tension transmission lines across the Columbia River between Hood River and White Salmon to connect the two power plants of the company in Hood River and the White River plant with the power plant at Husum, Wash., which will connect all stations in eastern Washington with the Oregon power divisions and link all of the company's units along the Columbia basin.

KLAMATH FALLS, ORE.—The California-Oregon Company contemplates the installation of a new street-lighting system in Klamath Falls. The request of the Keno (Cal.) Power Company for an electric franchise here has been refused.

STAYTON, ORE.—The Stayton Electric Light Company is contemplating extensive improvements to its plant to enable it to furnish electrical service to nearby towns and farms in this vicinity. C. E. Taylor is owner and manager.

BAKERSFIELD, CAL.—The City Council has given its approval for the erection of 240 electroliers in the business district.

ELSINORE, CAL.—The Southern Sierras Power Company of Riverside has extended its electric transmission lines in Cottonwood Canyon, and, it is reported, will extend them from Alberthill to Corona.

RICHMOND, CAL.—The Great Western Power Company of San Francisco, it is reported, will begin work as soon as the weather permits on the erection of a high-tension transmission line from an intersection with its 110,000-volt line through Moraga Valley out through Moraga and down San Pablo Creek to Richmond to connect there with the line which has been built westward from Crockett. Plans have been completed and work will soon start on the construction of a large substation near Crockett.

SAN FRANCISCO, CAL.—More than 80 per cent of the property owners and merchants in the "triangle district," the section bounded by Geary, Powell, Sutter and Kearny Streets, have signed for the installation of the "Path of Gold" lighting system along those streets, according to a report made to the Downtown Association.

SANTA BARBARA, CAL.—Work will soon begin on the erection of ornamental lamps on State Street. The plans provide for metal standards on State Street to Sola Street, and for concrete standards from Ic la Guera to the Boulevard.

BOISE, IDAHO.—Bids will be received at the office of the Supervising architect, Treasury Department, Washington, D. C., until March 8 for a new system of conduit and wiring and alterations in heating system in the United States assay office at Boise, Idaho. For details see proposal columns.

KENDRICK, IDAHO.—The Potlatch Consolidated Electric Company, of Kendrick, has been granted a franchise to erect and maintain electric transmission lines on the highways of the county.

MESA, ARIZ.—The proposal of the purchase of the property of the South Side Gas & Electric Company, which includes an electric-light plant and gas plant at $113,000, to be owned and operated by the municipality will be submitted to the voters.

PHOENIX, ARIZ.—The residents of the Higley section have recently voted to form a public improvement district, which will provide for electrical service.

ANACONDA, MONT.—The City Council has passed resolutions calling for the installation of lighting systems in Districts Nos. 70, 74 and 78.

BUTTE, MONT.—The Inter-Mountain Power Company of Butte, recently organized by parties identified with the Anaconda Copper Mining Company, has contracted with the Washington Water Power Company of Spokane for the purchase of electrical energy. The service will be supplied from the plant near Long Lake, 22 miles from Spokane.

ROUNDUP, MONT.—The local electric franchise, held by the Roundup Coal Mining Company, has been purchased by Messrs. Hopka, Straley and Mageath. The new owners, it is understood, will furnish service from the power plant of the coal mining company.

Canada

NELSON, B. C.—The installation of a third unit at the municipal electric-light plant has been recommended to the City Council by the fire, light and water committee.

WINNIPEG, MAN.—Tenders will be received by Thomas S. Johnson, minister of public works, Winnipeg, until Feb. 12 for various works required in the completion of the now partially erected new Parliament Buildings in the city of Winnipeg, including heating and ventilating, electric conduit and wiring, etc. Separate bids to be submitted on each classification of the work.

GALT, ONT.—Plans are being considered by the Hydro-Electric Commission for enlarging the main substation on Dickson Street.

HAMILTON, ONT.—Plans are being considered by E. I. Sifton of the Hamilton Hydro-Electric Department, for the installation of a storage system and booster pump at the Beach pumping plant, at a cost of about $25,000. A new transmission line will also be erected. The Hydro-Electric Department is also considering the installation of a reversible operative motor-generator set and storage battery at the Hughson Street Station.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 29 for steel, iron, steel pipe, steel cable, wire, copper tubing, sheet copper, sheet lead, sheet zinc, garbage and refuse incinerator, motor generator sets, turnbuckles, taps, pliers, etc. Blanks and general information relating to this circular (No. 113) may be obtained from the above office or the office of the assistant agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

1,212,163. RELAY FOR UNDULATORY CURRENTS; Eric Magnus Campbell Tigerstedt, Copenhagen, Denmark. App. filed Oct. 19, 1916. Variation in the electric conductivity effected by the ionizer takes place by means of a grate-like or sieve-like auxiliary electrode.

14,243. THERMO-ELECTRIC COUPLE; William H. Bristol, Waterbury, Conn. App. filed April 1, 1916. May be readily and quickly installed.

14,245. PROCESS AND APPARATUS FOR MAKING BRAZED JOINTS; Friedrich Wilhelm Heuser, Gross-Lichterfelde, near Berlin, Germany. App. filed Dec. 5, 1916. Electric arc.

1,211,388. PROTECTED ELECTRODE AND PROCESS OF MAKING THE SAME; Edmund Henry Becker, Washington, D. C. App. filed Oct. 18, 1916. Comprises a negative electrode for primary coils and the like composed of copper oxid, or copper oxids, and having a superficial coating or layer of amalgamated copper.

1,211,418. CONTROL SYSTEM FOR GUN MOUNTINGS AND OTHER MECHANISM; Arthur Trevor Dawson, Westminster, London, and James Horne, Barrow-in-Furness, England. App. filed Dec. 2, 1913. Improvements.

1,211,434. TELEPHONE-EXCHANGE SYSTEM; Charles L. Goodrum, New York, N. Y. App. filed March 17, 1915. Employing machine switching.

1,211,435. TELEPHONE SYSTEM; Edward Alfred Graham, Brockley, Londong England. App. filed Nov. 18, 1914. Relates to loud speaking type wherein the transmitter of one telephone instrument is connected directly or through a condenser to the receiver of a second telephone instrument and vice versa.

1,211,440. ELECTRIC SWITCH; Jay H. Hall, Cleveland, Ohio. App. filed Feb. 24, 1913. Magnetically operated.

1,211,443. ELECTRIC INSULATION; John Allen Heany, New York, N. Y. App. filed Nov. 9, 1916. Comprising a roving, sliver, or tape-line body of fibers.

1,211,448. TIME AND BURGLAR ALARM; Willis G. Hubbs, Walnut Ridge, Ark. App. filed Sept. 16, 1915. Alarm may be given when the doors or windows of a house are being forced.

1,211,465. FLASHLIGHT; John J. McGuckin, Brooklyn, N. Y. App. filed Aug. 25, 1916. Preventing the rolling out of place of such flashlights when they are laid upon inclined surfaces.

1,211,491. RECORDING APPARATUS; Max Seidler, Frankfort-on-the-Main, Germany. App. filed Jan. 7, 1914. Enable diagrams to be produced by means of a single apparatus in such a manner that, even where partly superimposed or intersecting, they do not become confused and may readily be followed.

1,211,492. ELCTRIC BELT; Victor Sence, New York, N. Y. App. filed June 25, 1912. Generating an electric current and transmitting the same through patient's body.

1,211,507. MAGNNETO ATTACHMENT; Harry Randolph Van Deventer, Sumter, S. C. App. filed Sept. 22, 1914. Spring arm made from stamped and formed sheet metal.

1,211,534. TELEPHONE SIGNAL DEVICE; Ura M. Boyd, Dallas, Tex. App. filed May 11, 1916. Time device for public phones.

1,211,545. MANUFACTURE OF STEEL; Godfrey John Boyle Chetwynd, West Riding, England. App. filed Jan. 2, 1914. To enable articles made of steel to be produced of better and more reliable quality throughout.

1,211,607. TELEPHONE APPARATUS; Maurice K. McGrath, New York, N. Y. App. filed June 30, 1915. Telephone sets intended for use in connection with automatic telephone systems.

1,211,612. SWITCHING DEVICE FOR TELEPHONE SYSTEMS; Daniel D. Miller, New York, N. Y. App. filed June 8, 1915. Electromagnetic device which will operate efficiently upon direct current but will offer a high impedance to alternating currents of talking frequencies.

1,211,617. DYNAMO-ELECTRIC MACHINE; Alfons H. Neuland, San Francisco, Cal. App. filed Aug. 27, 1913. Possesses a very large power capacity in proportion to its size.

1,211,623. ELECTRICALLY-OPERATED PIANO PLAYER; Walter C. Reed, Dalton, Mass. App. filed Jan. 29, 1913. Improvements.

1,211,628. ELECTRIC SWITCH; Joseph Sachs, Hartford, Conn. App. filed March 25, 1915. Simple in construction.

1,211,629. ELECTRIC SWITCHING AND METER-TESTING SYSTEM; Joseph Sachs, Hartford, Conn. App. filed April 28, 1915. Comparatively small number of parts, a large variety of differently functioning appliances can be obtaind.

Record of Electrical Patents

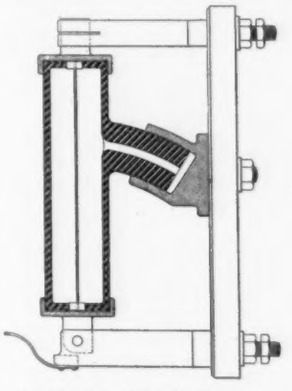
Notes on United States Patents issued on Jan. 9, 1916.

1,211,644. AUTOMATIC ALARM SYSTEM; Behrend Ulferts, Lakefield, Minn. App. filed July 27, 1915. Indicating to the engineer of a train approaching a switch point whether or not, by the action or non-action of the signal mechanism, the switch is open or closed.

1,211,675. RAILWAY SIGNAL; Elmer R. Coe, Wilkinsburg, Pa. App. filed Nov. 14, 1914. Electromagnetic device which is employed to control holding device and which when energized permits the holding device to perform its two functions just mentioned.

1,211,687. APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF WATER; Arthur Dohmen, Cologne, Germany. App. filed Oct. 20, 1913. Filter press.

1,211,688. TELEPHONE SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed Nov. 12, 1904. Improved telephone exchange system wherein advantages of automatically and manually controlled line connectors are present and disadvantages in these classes of apparatus are eliminated.



1,211,778—Circuit Breaker

1,211,689. TELEPHONE-EXCHANGE SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed June 19, 1905. Calling lines are automatically connected with the answering ends of link circuits while the called lines are connected with link circuits by means of manually manipulated terminals such as plugs of said circuits.

1,211,694. RECTIFIER; John M. Fitzgerald, Chicago, Ill. App. filed Feb. 15, 1915. For converting alternating current into uni-directional pulsating current, and vice-versa.

1,211,752. ELECTRIC CONTROLLING MECHANISM; Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. App. filed Oct. 15, 1915. Dental surgical work.

1,211,754. CRYSTAL RECTIFIER; Paul C. Rawls, Des Moines, Iowa. App. filed July 6, 1914. Used in high-frequency oscillation detectors in wireless telegraphy or telephony.

1,211,759 ILLUMINATED PAD HOLDER; Thomas Robins, New York, N. Y. App. filed March 21, 1916. Incandescent electric lamp or lamps for illuminating the surface of the pad.

1,211,768. ELECTROMAGNETIC VIBRATOR; Wolfgang E. Schwarzmann and Charles M. Wild, Springfield, Mass. App. filed Aug. 10, 1914. For use in electrical ignition systems.

1,211,770. MICROMAGNETIC DETECTOR; Frederick G. Simpson, Seattle, Wash. App. filed Nov. 1, 1912. For the reception of signals of the Hertzian wave type.

1,211,778. CIRCUIT BREAKER; Halfdan A. Steen, Norwood, Ohio. App. filed March 23, 1912. Use the pressure suddenly developed by blowing of the fuse to move to off position a switch arm which normally engages stationary contacts for completing a circuit.

1,211,788. RAILWAY-TRAFFIC-CONTROLLING APPARATUS; John D. Taylor, Wilkinsburg, Pa. App. filed Aug. 28, 1913. For controlling a railway switch from a distant point.

1,211,802. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph Lester Woodbridge, Philadelphia, Pa. App. filed Nov. 26, 1913. Systems in which a source of electrical energy of variable voltage is used to supply energy for constant voltage translating devices, such as electric lights.

1,211,803. VOLTAGE REGULATION; Joseph Lester Woodbridge, Philadelphia, Pa. App. filed Dec. 4, 1914. Employ as part of the controlling circuit a resistor having a temperature co-efficient so markedly negative that over a certain range of current values the voltage across the resistor decreases to a marked extent with increase of current.

1,211,822. LIGHTNING ARRESTER; Alexander Chernyshoff, Swissvale, Pa. App. filed April 1, 1915. Utilize concentrated capacity concentrated resistance, concentrated inductance, and ground connections to comprise the elements of a lightning arrester.

1,211,863. APPARATUS FOR AND METHOD OF PRODUCING HIGH-FREQUENCY CURRENTS OF ELECTRICITY; David G. McCaa, Lancaster, Pa. App. filed Sept. 24, 1913. Arcing of a current of electricity across a spark gap, which is included in the circuit of said current, may be absolutely prevented.

1,211,940. PLUGGING-IN SWITCH; William S. Harlow, Swampscott, Mass. App. filed Dec. 1, 1913. Provides convenient means for introducing testing instrumnets into the line without interfering with the continuity of service.

1,211,963. RADIO RECEIVING APPARATUS; John A. Proctor, Revere, Mass. App. filed June 29, 1914. Operated by oscillations produced by continuous or undamped electric waves, without the employment of any form of make-and-break device.

1,211,967. OVERLOAD CIRCUIT-BREAKING APPARATUS; Edmund O. Schweitzer, Chicago, Ill. App. filed May 19, 1913. Improvement.

1,211,973. ELECTRIC HEATER; Vern Slater and Leonidas D. West, Denver, Col. App. filed June 9, 1916. Current of air is induced through a casing having an electric heating element therein.

1,211,976. NOVELTY DEVICE; John R. Spencer and James L. Ross, Bartow, Fla. App. filed April 26, 1915. Illuminated campaign buttons or pins.

1,212,062. PROCESS FOR THE PRODUCTION OF CUPROUS OXID ELECTROLYTICALLY; Bertram Hunt, Glasgow, Scotland. App. filed Oct. 7, 1916. Electrolysis of metallic copper.

1,212,072. SYSTEM FOR FIRING EXPLOSIVES IN MINES; Camden Eugene Knowles and Leroy Daniel Cornelius, Pittsburg, Kan. App. filed June 9, 1916. Air or other fluid under pressure may be utilized for operating circuit closers.

1,212,082. ELECTRICALLY-HEATED SAD IRON; Ernest V. Manzella, Chicago, Ill. App. filed Aug. 25, 1916. Electric current is thermostatically controlled.

1,212,091. TELEPHONE ATTACHMENT; John Oscar Moisson, Charleston, S. C. App. filed July 5, 1916. Causing a signal to be sounded when the user of the telephone leaves the receiver off the hook.

1,212,119. PROCESS OF PRODUCING ALUMINIUM NITRLD; Ottoker Serpek, Paris, France. App. filed April 14, 1915. Mixture of carbon and aluminous material is heated in an atmosphere containing nitrogen.

1,212,125. SWITCH FOR HEAVY ALTERNATING CURRENTS; Walther Burstyn, Berlin, Germany. App. filed Jan. 14, 1915. Electromagnetic of a pneumatic, or a hydraulic, switch.

Record of Patents Issued Jan. 9

(*Continued from the Issue of Jan. 13*)

1,211,050. APPARATUS FOR TRANSMITTING MOVEMENTS OR POSITIONS OF INDEXES BY MEANS OF MULTIPHASE-WOUND BODIES; Erich Beckmann, Hanover, Germany. App. filed Jan. 14, 1913. Improvements.

1,211,009. ELECTRIC WELDING-TOOL; George L. Thornton, Huntington, W. Va. App. filed Oct. 19, 1916. Manual tool for holding the electrode.

1,211,083. ELECTRIC SIGNAL SYSTEM; Alva H. Caven, Youngwood, Pa. App. filed Oct. 23, 1914. In which the traffic in both directions is caused at one point to be diverted to a single track.

1,211,091. CATHODE-RAY DEVICE; William D. Coolidge, Schenectady, N. Y. App. filed Sept. 26, 1916. Pure electron discharge independent of gas ionization.

1,211,092. X-RAY TUBE; William D. Coolidge, Schenectady, N. Y. App. filed June 5, 1915. Current input high enough to heat the working face of the anode to incandescence.

1,211,102. ELECTRIC HEATING UNIT AND METHOD OF MANUFACTURING THE SAME; Robert William Davis, Jr., Aspinwall, Pa. App. filed Aug. 26, 1912. Improved heater.

1,211,088. ELECTRIC RAILWAY; James M. Clark, Macon, Ga. App. filed Jan. 22, 1916. For actuating switches, signals.

1,211,116. THERMOSTATIC APPARATUS; Bruce V. Edwards, Newark, N. J. App. filed March 28, 1914. Volumetric changes of a fluid body will operate to control the circuit through the medium of a flexible diaphragm.

1,211,117. THERMOSTATIC APPARATUS; Bruce V. Edwards, Newark, N. J. App. filed March 28, 1914. To control an electric circuit for sounding an alarm.

1,211,121. FLASH-LAMP; Henry L. Everett, Philadelphia, Pa. App. filed May 4, 1916. Facilitating the removal of the cell and of the lamp, especially after the bulb of the lamp has been broken.

1,211,128. ELECTRICAL CONNECTOR; Harry Frankel, New York, N. Y. App. filed April 20, 1916. Wire and terminal connector.

1,211,140. RAILWAY SIGNALING; Henry W. Griffin, New York City, N. Y. App. filed Jan. 27, 1913. Signaling on stretches of single track over which traffic moves in both directions.

1,211,141. RAILWAY SIGNALING; Henry W. Griffin, New York, N. Y. App. filed. Oct. 19, 1916. Signaling for stretches of single track over which traffic moves in both directions.

1,211,142. RAILWAY SIGNALING; Henry W. Griffin, New York, N. Y. App. filed Oct. 13, 1916 Stretches of single track between passing sidings.

1,211,153. ELECTRICAL CONDUCTOR; Martin Hochstadter, Berlin, Germany. App. filed Jan. 16, 1915. For overhead transmission lines and for underground cables.

1,211,182. MOUNTING-STRIP FOR SWITCH-BOXES; Edward H. Kruse, Fort Wayne, Ind. App. filed Feb. 17, 1916. Use of ordinary nails.

1,211,208. AUTOMOBILE OR MOTOR-CYCLE HORN; Ray H. Manson, Elyria, Ohio. App. filed May 15, 1915. To cause the actuation of a diaphragm.

1,211,218. PROCESS FOR PLATING METALS; Clark W. Parker, Detroit, Mich. App. filed July 31. 1916. To reduce the number of operations.

1,211,220. AUTOMATIC SUBSTATION; Charles W. Pen Dell, Chicago, Ill. App. filed May 13, 1915. Arranged to keep the supply practically uninterrupted.

1,211,279. TURNING AND STOPPING SIGNAL FOR AUTOMOBILES; John Boeck, Boise, Idaho. App. filed June 22, 1916. To be projected from one side of the car when turning corners.

1,211,281. ELECTRIC SWITCH; Benjamin S. Bowers, Laprairie, Minn. App. filed Sept. 19, 1914. For use in train dispatchers' telephone and telegraph systems.

1,211,313. METHOD OF AND ELECTRODE FOR WELDING BONDS TO RAILS; Albert B. Herrick, New York, N. Y. App. filed Nov. 29, 1912. Ren. June 23, 1915. New and useful improvement.

1,211 322. FLASHLIGHT SWITCH; Martin B. Langdon, Pardeeville, Wis. App. filed March 14, 1916. Lever or cam member.

1,211,330. DIRECTIONAL SIGNAL; James Marcello, Greenwich, Conn. App. filed May 24, 1916. For use in connection with automobiles, motor trucks and the like.

1,211,363. BATTERY; Charles F. Burgess, Madison, Wis. App. filed Sept. 18, 1914. Leclanche type.

1,211,376. ELECTRON-DISCHARGE APPARATUS AND METHOD OF OPERATING THE SAME; William D. Coolidge, Schenectady, N. Y. App. filed March 30, 1915. Operation of an X-ray device.

1,211,378. SYSTEM OF SELECTIVE ELECTRICAL DISTRIBUTION; Charles F. Kettering and William A. Chryst, Dayton, Ohio. App. filed Nov. 20, 1912. Provides a plurality of electrical sources and circuits, having controlling elements operable to accomplish certain predetermined functions.

1,211,380. SYSTEM OF ELECTRICAL DISTRIBUTION; Percy H. Thomas, Upper Montclair, N. J. App. filed Feb. 3, 1913. For operating mercury vapor rectifiers.

1,206,911. SYSTEM OF RADIO COMMUNICATION; Greenleaf W. Pickard, Amesbury, Mass. App. filed Oct. 28, 1914; issued Dec. 5, 1916. A static-coupled transmitter of the impact excitation type, in which a quenched gap circuit is associated with a reservoir circuit, and that in turn with a detuned radiating circuit, through the agency of condensers.

1,208,187. APPARATUS FOR GENERATING HIGH-FREQUENCY ELECTRICAL OSCILLATIONS; Frederick H. Millener, Omaha, Neb. Original application filed April 10, 1911; divided Nov. 7, 1912; issued Dec. 12, 1916. An arc oscillator for radiotelephony, of the rotating electrode type.

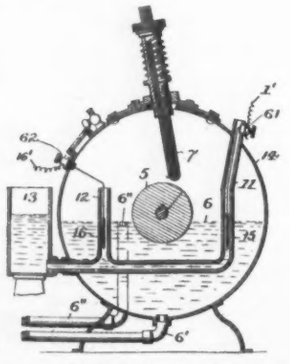


Fig. 1—Milleuer's Arc Generator

One of the electrodes dips into an electrolyte which is dissociated to produce the desired hydrogen atmosphere within the arc chamber.

1,209,324. ELECTRON EMITTING CATHODE AND PROCESS OF MANUFACTURING THE SAME; Alexander McL. Nicolson, New York, N. Y., and Emerson C. Hull, Montclair, N. J. App. filed Dec. 26, 1914; issued Dec. 19, 1916. A filament for a vacuum tube of the audion type, in which a metal such as platinum is treated to produce a multiple coating containing metals of the alkaline earth group, as, for example, barium and strontium.

Discussion

It is noteworthy that in the month of December only three patents having to do with the radio arts were issued. Ordinarily from three to five times this number appear each month.

The patent to G. W. Pickard, No. 1,206,911, is of particular interest. As shown in Fig. 1, which is reproduced from the specification, it is based upon the disclosure of a quenched spark gap transmitter which involves condenser couplings between its several circuits. In the diagram, *F* represents a motor generator and *T* a transformer, both of the ordinary type used in wireless telegraphy. Across the secondary of the power transformer is connected the quenched spark gap *G*, and about it the closed impulse circuit comprising the condensers *C* and *K* and the variable inductance *A*. Across one of these condensers, and coupled by it to the impulse or exciting circuit, is a second closed circuit including the condenser *D* and the variable inductance *B*. The antenna and ground are connected to the terminals of condenser *D*, no loading coil being shown. The patentee states that the impulse circuit and the reservoir circuit are co-ordinated and adjusted so that the spark-discharge energy is transferred to the latter in the shortest possible time, and that the persistent radio frequency oscillation which thereafter exists in the reservoir circuit *KBD* has its energy slowly fed into the antenna or radiating circuit. The emitted wave length is determined by the period of the closed circuit *KBD*; in an example cited this is 422 meters, while the natural period of the radiator corresponds to a wave length of 250 meters. The detuned condition thus existing is relied upon to cause slow radiation and to prevent reaction between the antenna and reservoir circuits. The impulse circuit is prevented from reacting with the reservoir circuit by the opening characteristic of the quenched spark gap. Thus, it is stated, radiation of a pure monoperiodic wave at high efficiency is secured. With a power transformer input of 1 kw. the "radiation" claimed is 800 watts.

A magnetic loop receiver is shown and described, although the claims of the patent all refer to the transmitter alone. The right-hand portion of Fig. 2 shows how the magnetic loop of large area, *L*, is associated with detector G^1 and telephones T^1 by means of the tuning variable condenser D^1. A second condenser, *U*, is shunted across the telephone windings, thus providing a by-pass for the oscillation current groups and partially tuning the telephone circuit to the wave train frequency. It is pointed out that the highest receiving efficiency is secured by suppressing reradiation from the receiver and by choosing the wave-train frequency to agree with the natural vibration rates of the telephone diaphragm and the telephone circuit T^1 *U*.

Recent Radio Patents

Notes and Comments on United States Patents on Radio Signaling and allied topics issued during December, 1916.

The mechanical structure of F. H. Millener's electrolytically gas-generating arc oscillator may be seen from Fig. 1, which is the fourth drawing of his patent No. 1,208,187. The remaining details of the wireless telephone arrangement which he proposes are shown in other drawings of this patent, and described in the several specifications which have been issued to this same pattentee within the past few months. The present application is directed toward the arc itself, and explains the way in which the roating positive electrode 5, which may be of copper, serves as one terminal of the oscillating arc which is drawn to the adjustable carbon negative 7. The copper element 5 dips into a cooling liquid, 6, which is fed into the bottom part of the arc chamber is a U-tube system 12, which

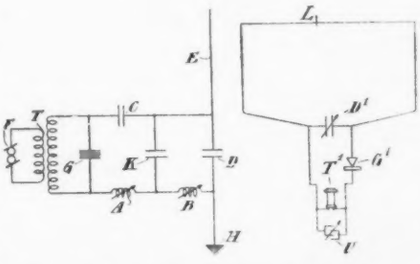


Fig. 2—Pickard's Transmitter and Receiver

prevented from rising too high on the positive electrode by the outlet 6". Within the arc chamber is a U-tube system, 12, which connects to an external reservoir, 13, containing an electrolyte such as potassium hydrate. The two arms of the tube are of different lengths, one terminating within the arc box and one leading out into the free atmosphere. Electrodes 15 and 16 are placed within these vertical arms, and immersed below the level of the electrolyte. By means of the binding posts 61 and 62, the electrodes 15 and 16 are connected to the main source of direct-current power for the arc, a controlling resistance being interposed to limit the current. By properly choosing the polarity of the electrodes 15 and 16, hydrogen will be liberated from the electrolyte within the shorter tube and will pass upward into the arc chamber. Oxygen produced in the other leg of the tube escapes into the air outside the arc box. As is well known, the presence of hyrogen in the atmosphere immediately surrounding an arc of this type aids materially in steadying the oscillations produced. Further, the rotation of the copper electrode 5 helps to maintain the generated oscillations of constant amplitude by preventing irregular burning and pitting at the arc. Thus, the entire structure provides a hydrogen oscillator for wireless telephony in such form that no external tank or generator system is needed for the supply of gas.